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Making Memories

WHERE do you live?

In those many moments when your mind is not concentrated upon the daily task or exchanging impressions with other minds, or absorbing, by reading, the thoughts of others; in the intervals of the day and the watches of the night, where and with whom do you pass your time?

Back and forth, here and there, over miles of space and years of duration with the speed of thought you are carried to the scenes of your childhood and school days, to incidents of your later life, to association with those whom you have known.

On the suggestion of a thing so trivial that you often do not recognize it as the cause — a word or phrase, a resemblance or mannerism, a sound, a snatch of song, a scent, a flower, a book, a picture — a sequence of ideas will snatch you back to scenes through which you have lived and associations that have been built into your living.

Many of the experiences through which you have passed, many of the people whom you have met, you can recall with difficulty. Many memories are persistent and some few localities the habitual habitat of your mind. Your mental existence outside of current concentration, speculation and planning is made up of past impressions.

And it is not the most pleasant and meritorious of one's experiences to which his mind most frequently reverts. There are those that are sullied by self reproach, embittered by resentment, clouded by regret.

Of these, as well as of the brighter ones, his conscious existence must always consist.

How much he would give to live some of them over again and live them differently. How much remorse and heartburning he would have saved if upon occasions he had spoken or acted differently.

And, any day he may be passing through another one of these incidents that will be built as a persisting figure into the mosaic of memories that will be so large a part of his future life.

How much it will mean to him as the years gather and the possibilities of the future diminish and past conduct and achievement approach the sum of possible accomplishment, that these experiences in the memory of which he must dwell shall be such as he shall like to look upon, and that he may so continue to live "That action hence borne out may waste the memory of the former days."

Selecting a Power Plant for a Hotel

The Engineering and Economic Considerations That Entered into the Selection of Power and Heating Equipment for a Large Hotel

A HOTEL requires both power and steam for its operation throughout the year. Steam is needed for heating the house-service water, and for general service water in the kitchen, laundry and for cleaning. Large quantities of steam are also used in the laundry; this, however, is at a pressure around 90 lb. gage, and in the kitchen for cooking at about 40 lb. gage. The other services can use low-pressure exhaust steam from the engines that drive the electric generators. The high-pressure steam for the laundry and kitchen make the installation of high-pressure boilers necessary whether power is generated or not.

The demands for low-pressure steam for the various services synchronize with the power load fairly well. In the morning, when the guests begin to make ready for the day, they turn on lights and also use hot water. In addition they begin to move about, and the demand for power in the elevator service increases. To take care of the breakfast requirements increases the demand for exhaust steam.

The steam and power requirements fluctuate throughout the day, rising to another peak at noon, but the increased demand for cooking and other purposes is accompanied by an increased need for power for elevator service, lighting, etc. Again in the evening when the requirements for power for elevator service and lights are the highest, the demand for steam by the guests for hot water is high, as are the requirements for the kitchen service. The refrigerating load, which should be driven by electric motors, can be used to some extent to help balance the load on the engines with the demands for steam and hot water for the various services. These conditions make it favorable for a hotel to operate its own power plant. At times during the summer some exhaust steam from the engines may have to be discharged to the atmosphere, but in the winter a large amount of steam must be supplied directly from the boilers through reducing valves to the heating system, as the low-pressure steam demands will be in excess of the exhaust from the power load.

Decided To Install Isolated Plant

For the foregoing reasons, when the owners of the new Empire Hotel, New York City, were considering a power supply for the building, an isolated plant was decided upon. The owners of the building, previous to its construction, had operated a number of other hotels and were convinced from this experience that an isolated plant is the cheapest source of supply for the power and heating requirements. With this experience to guide them, when Otto E. Goldschmidt, consulting engineer of New York City, was retained by the hotel owners to figure on the power and heating equipment, he was not requested to make a report on the cost of purchased versus generated power. From Mr. Goldschmidt's experience, as consulting engineer, with laying out the power and heating equipment in about 35 other hotels, he was of the same opinion as the builders of the Empire Hotel. Therefore the only thing to consider was the kind of a power plant that would best suit the requirements of the new building under local conditions.

Both oil and coal were considered as fuel, but on account of the uncertainty of the price of oil, it was decided to use coal.

Water-Tube Boilers Selected

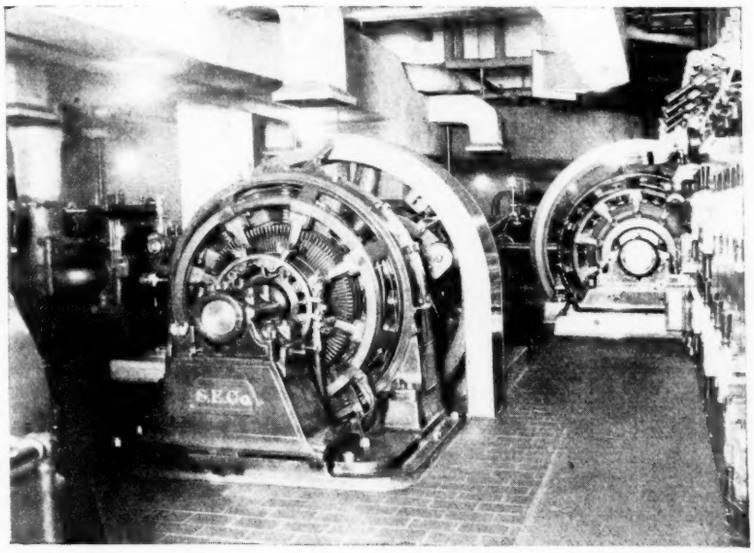
Three inclined water-tube boilers were selected, one of 3,040 sq.ft. of steam-making surface and two, each of 2,560 sq.ft. of steam-making surface. These boilers were equipped with underfeed, horizontal, single-retort, side-dump stokers and motor-driven forced-draft fans. This made it possible to operate the boilers over a wide range of rating at good efficiency and burn a low grade of coal. During the summer the load can be carried on the one large boiler, and in winter the large boiler and one of the small units can easily take care of the steam demand. When the large boiler is taken out of service for cleaning, the two small boilers can carry the load by forcing. A steam pressure of 175 lb. gage and 100 deg. F. of superheat was chosen, as these were well suited to use in unaflow engines and could also be used through reducing valves for low pressure in the heating system to make up any deficiency in the amount of exhaust. These steam conditions also allowed reducing to 90 lb. for use in the laundry and to 40 lb. for the kitchen.

Unaflow Engines Used To Drive Direct-Current Generators

To furnish power, three unaflow engines connected to three-wire 110- and 220-volt direct-current generators were selected. One of the chief reasons for selecting unaflow engines was their high efficiency over a wide range of load, being about a straight line from 50 to 125 per cent of rating. Three units were provided, rated at 300, 200 and 125 kw. respectively. The large unit has sufficient capacity to carry the load during all times of normal operation and do it with only small variation in efficiency. In case of unusually high peaks, one of the small machines can be put into service also. During light-load periods at night one of the small machines can be operated and the large machine shut down. In case the large machine has to be taken out of service for repairs, the two small units can be operated in parallel to take care of the load.

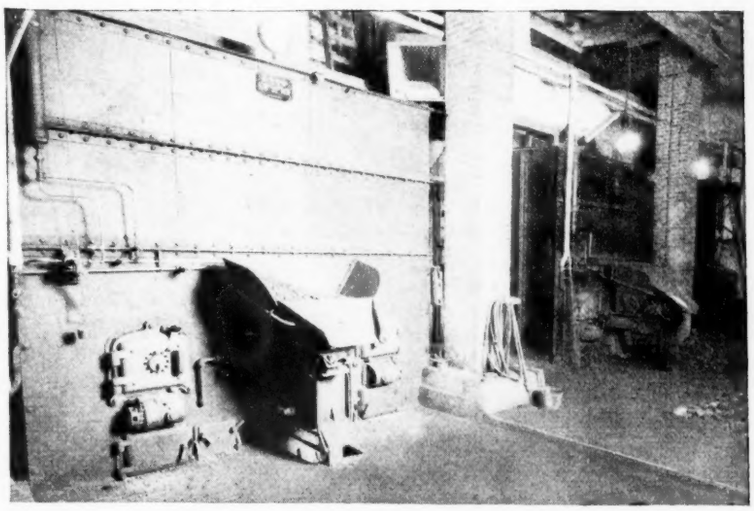
House hot water, at a temperature of 140 deg. F., is supplied from closed heaters using exhaust steam from the engines at a back pressure not to exceed one pound. Service hot water is supplied from a similar heater at a temperature of 160 deg. F.

The house-heating-system vacuum pumps are steam driven, since in the heating season there is always a shortage of exhaust steam and the exhaust from these pumps can be taken into the system at all times. The load on the pumps synchronizes with the heating re-



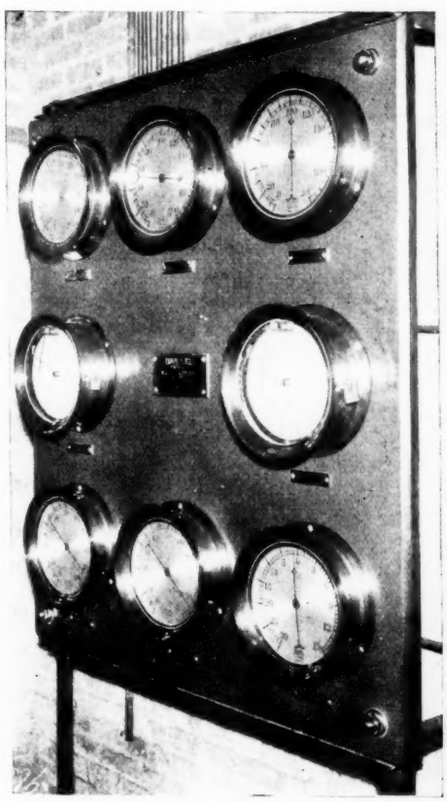
Left—Power plant contains three 3-wire 110- and 220-volt direct-current generators rated at 125, 200 and 300 kw. respectively, and driven by uniflow engines

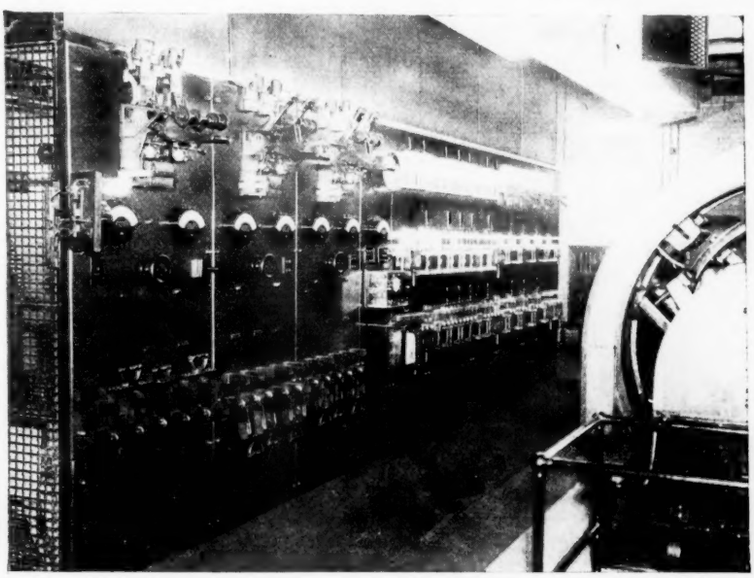
Below—Boiler room contains three water-tube boilers, two of which have 2,560 sq.ft. and one has 3,040 sq.ft. of steam-making surface, designed for a steam pressure of 175 lb. gage and 100 deg. of superheat



Below—Indicating and recording pressure gages for boilers and low-pressure steam lines

Lower Right—Switchboard for control of the three generators and the distribution circuits





quirements. When the demand for steam is the heaviest, the pumps are doing their greatest work, and as the demand for heat diminishes the load on the pumps decreases. During the winter months the heating elements in the hot-water heaters are connected into the steam-driven vacuum pumps on the house-heating system. When these pumps are out of service in the summer months, a small motor-driven vacuum pump operates on the heating elements of the hot-water heaters. All clean low-pressure drips go to the vacuum pumps and are returned to the feed-water heater.

Steam-Driven Boiler-Feed Pumps Are Used

Steam-driven boiler-feed pumps are used, since the additional cost for electric pumps of such small capacity and high pressure was not warranted by the heat that could be saved in the short period during each year when exhaust steam would be blowing to the atmosphere. The efficiency of a small high-pressure centrifugal pump, as used for boiler-feed purposes, is so low as to make the quantity of steam required for supplying water to the boilers not very much in favor of the electric-driven pump. For boiler-feed service the highest reliability was desired, and it was felt that this was in favor of the steam-driven pump. An open feed-water heater is used and is located so as to provide a head of about 8 ft. on the pumps, which returns the water to the boilers at about 210 deg. F.

All the high-pressure drips are returned directly to the boiler by a Holly loop system, as it was considered that this eliminated one of the sources of large losses in many steam plants and required a minimum of attention. Traps are used on all low-pressure drips, and these are returned to the vacuum pump as previously mentioned.

Steam-driven house-service pumps are used. The hotel at the present time is 14 stories high, but at some future time will be increased to 20 stories. If motor-driven centrifugal pumps had been chosen, it would have been necessary to change the pumps when the height of the building is increased. The roof tanks on the fire-protection system are connected into the house-service pumps, and this made it advisable to use steam-driven pumps on account of their greater reliability. By combining the two services, house and fire, into one pump, considerable in cost for pumps was saved, besides the pump on the fire service is a unit in regular use, which is additional insurance of its operating when wanted in an emergency.

Two Motor-Driven Refrigerating Machines

In the refrigerating plant there are two motor-driven compressors, rated at 30 and 8 tons respectively. All the other equipment in the refrigerating plant is also motor-driven. During the periods of greatest demand the 30-ton machine is operated, and the 8-ton when the load is light. This helps to balance the exhaust steam supply in the summer with the heating requirements.

The boilers are equipped with automatic feed-water regulators and automatic draft regulator; the latter controls the position of the damper and the speed of the forced-draft fans. A V-notch recording meter is installed on the feed-water heater, and recording pressure and indicating gages are used on all the steam-service lines.

[Information in this article was supplied by Otto E. Goldschmidt, consulting engineer, and Fred Ludemann, chief engineer, Empire Hotel.—Editor.]

Why Air Must Be Vented from Radiators

An article in the Sept. 29 issue of *Power* entitled, "Can Air Carry Moisture," devoted considerable space to the fact that the presence or absence of air does not affect the amount of water vapor that can be held in a given space at a given temperature. The illustration given consisted of a closed box with a thin layer of water on the bottom, the box and its contents being maintained at any desired temperature.

One reader questioned the truth of the claim made, calling attention to the necessity of venting air from radiators if good results are to be obtained. He asked, in effect, "Why bother to vent this air if a given space can contain as much vapor whether the air is there or not."

The following, which is quoted almost verbatim from the letter in reply, may be of interest to other engineers who have been puzzled by the same question.

Imagine two steam radiators disconnected from the piping and sealed airtight. Let one radiator "contain" a vacuum, and the other air at atmospheric pressure. Through a seal introduce a pint of water into the bottom of each radiator. Then sink the two in a tank containing water at 180 deg. F.

An excess of water being present in each radiator, and the temperature being 180 deg. in both cases, the same weight of water vapor will eventually be present in both radiators, namely, 0.0199 lb. per cu.ft. (see steam tables).

The pressure in the radiator without air will be 7.51 lb. absolute, which is the vapor pressure for 180 deg. That in the radiator containing air will rise to 7.51 lb. gage, or 7.51 + 14.70 = 22.21 lb. absolute.

The condition here is one of equal temperatures but different pressures corresponding to that discussed in the Sept. 29 article. Now the opposite is true of two radiators connected to the same boiler. Here the pressures are equal. The temperatures must then differ if one contains air and the other does not.

Assume the pressure to be 17 lb. absolute in both radiators. Then the steam in the radiator with no air would have a temperature of 219 deg. F. corresponding to this pressure. Suppose the other radiator contains enough air to produce a pressure of 5 lb. absolute and that steam is admitted and mixed with this air. The total pressure cannot exceed 17 lb., so the actual vapor pressure will be 17 — 5 = 12 lb., corresponding to 202 deg. Obviously, this radiator would not be as effective as the other.

Suppose the radiator is entirely full of air at atmospheric pressure at the start. Turning on the steam would raise the total to 17 lb. absolute. With perfect mixing the actual steam pressure would be 17 — 14.7 = 2.3 lb. absolute. The steam would weigh only 0.0065 lb. per cubic foot and would have a temperature of 131 deg. F., so that the radiator would function badly.

With no mixing at all the air in the radiator would compress to 17 lb. absolute, leaving a little space near the inlet valve for steam at that pressure. In order to heat the whole radiator it would be necessary to vent the air.

Actual conditions would lie between the two extremes of perfect mixing of steam and air and no mixing. In any case the venting of air is essential if the full heating capacity of the radiator is to be realized.

Changing a Two-Phase Winding for Three-Phase Operation

By FRANK HUSKINSON

WHEN changing the winding in an induction motor, if data from the original winding are at hand, the calculations for the new winding can generally be made quite simple. This will be seen by the following, which shows how the winding in a 5-hp. 220-volt 1,200-r.p.m. two-phase 60-cycle squirrel-cage induction motor was changed for three-phase operation at the same voltage and frequency. The original winding was as shown in Figs. 1 and 3. As this type of winding would not permit of a regrouping for a change in the number of phase, it was decided to make a new winding and use diamond-shaped coils in a two-layer winding.

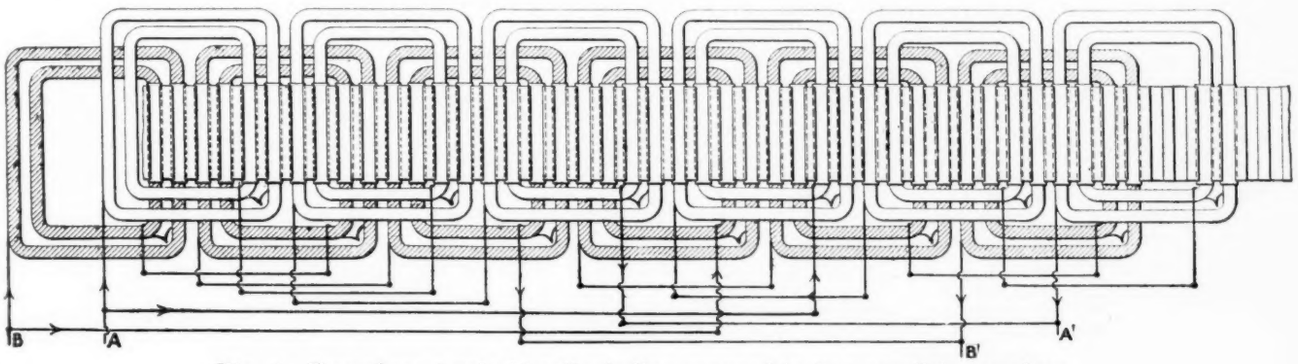


Fig. 1—Two-phase 6-pole 24-coil winding grouped in two parallels per phase

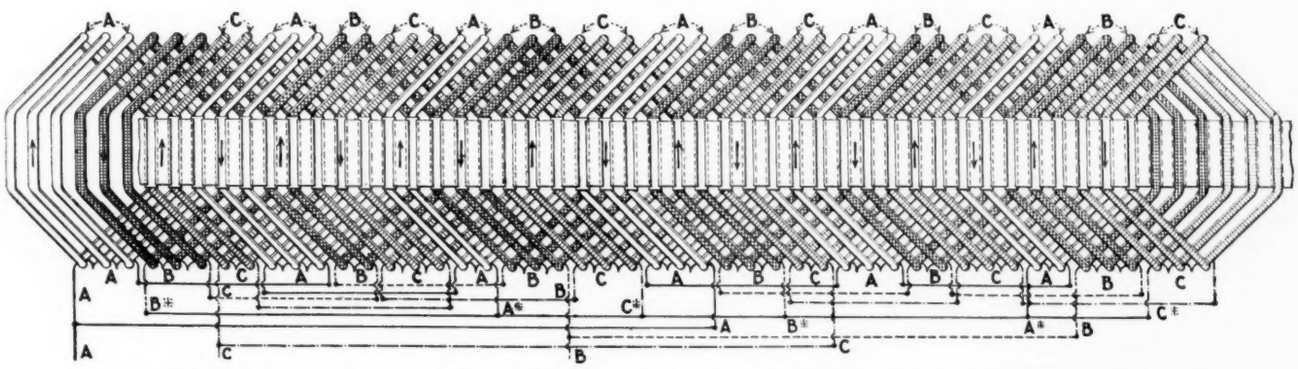


Fig. 2—Three-phase 6-pole 48-coil winding grouped in two parallels per phase and connected in star

The motor's stator core had 48 slots and 24 coils wound with a pitch of 1 and 8 and 1 and 6, with each phase connected in two parallels, there being two coils per pole-phase group. Each coil had 39 turns of No. 13 double-cotton-covered wire. Since there were 24 coils in the two-phase winding, there were $24 \div 2 = 12$ coils per phase. The number of poles in the motor equals $(120 \times \text{cycles}) \div \text{r.p.m.}$, or $(120 \times 60) \div 1{,}200 = 6$. Dividing the number of coils per phase by the number of poles in the motor gives the coils per pole or $12 \div 6 = 2$, as indicated in Fig. 1. The connections in this winding were two parallels, that is, the coils in one phase were divided into two equal groups and the two groups connected in parallel, so this gave $12 \div 2 = 6$ coils in series across the line, or 220 volts. Each coil had 39 turns, so that the total number of turns in series was $39 \times 6 = 234$. Then the volts per turn equal $220 \div 234 = 0.94$ volt.

In using these data for a three-phase winding, the star voltage of a three-phase 220-volt circuit may be used, which is $220 \div 1.732 = 127$ volts. Dividing the three-phase star voltage by the volts per turn of the two-phase 220-volt circuit, gives $127 \div 0.94 = 135$ turns in series per phase in the three-phase winding. There were 24 coils in the two-phase winding. In the three-phase winding there would be $24 \div 3 = 8$ coils per phase. The coils per phase divided by the number of circuits in parallel per phase equal the number of coils in series. In the two-phase winding there were two circuits in parallel per phase, therefore there will be $8 \div 2 = 4$ coils in series per phase in the three-phase star winding. The turns, 135, divided by the coils, 4, gives $135 \div 4 = 34$ turns per coil. Therefore 34 turns per coil are needed for the three-phase winding if only 24 coils are used. As the motor is to be wound for 6 poles, it is not possible to group 24 coils to give a balanced three-phase winding in the motor.

As there are 48 slots, 48 coils having 17 turns each can be used and 8 coils connected in series instead of four.

A three-phase 220-volt 60-cycle 5-hp. motor will require approximately 13 amperes per terminal at full load. Using 600 circ.mils per ampere per terminal, for a single circuit equals, $13 \times 500 = 7{,}800$ circ.mils cross-sectional area required for the coil conductors. As the rewind data are figured from the original two-phase winding, which was a 2-parallel connection, the new three-phase winding should also be a 2-parallel connection, which will give $7{,}800 \div 2 = 3{,}900$ circ.mils for the size of wire. Referring to a standard wire table, it will be found that a No. 14 wire has an area of 4,106 circ.mils. Then each coil should have 17 turns of No. 14 wire. As a No. 14 wire is a little stiff and hard to put in the slots and as there is ample room in the slots, two No. 17 wires can be used instead of one No. 14. This makes a neat coil and one that is easy to put in the slots. As the three-phase winding has 48 coils, the grouping will be $48 \div 3 = 16$ coils per phase, or $16 \div 6 = 2\frac{2}{3}$ coils per pole per phase. In order to group the coils for 6 poles, it will be necessary to arrange them in the following order: 3-3-2, 3-2-3, 2-3-3, 3-3-2, 3-2-3, 2-3-3. This gives the same number of coils in series in each circuit and also an equal number in each pole. In the three-phase winding a pitch of 1 and 7 is used, that is, the coils lie in slots 1 and 7. A diagram of the winding and its connections are shown in Fig. 2, and the stator completely wound is shown in Fig. 4 with all connections made, ready to be sprayed or dipped in a baking varnish and baked.

Several motors of this type have been rewound and have proved satisfactory in every way. Full-load tests

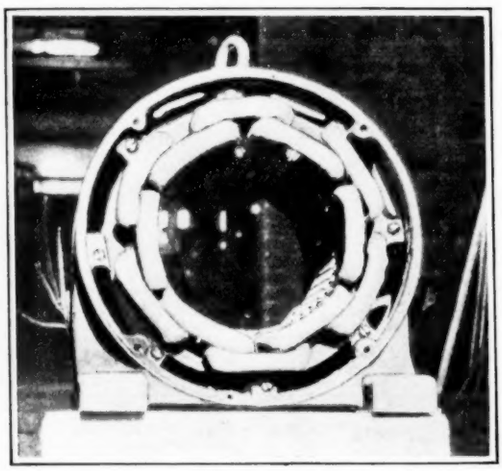


Fig. 3—Two-phase six-pole winding originally in the motor

and no-load tests made on these motors before and after rewinding have checked up very closely.

Where a two-phase motor has a distributed winding, it can be reconnected for three-phase operation and rewinding may not be necessary. When this is done, it should be remembered that the winding of a two-phase motor is good for about 25 per cent more voltage when connected for three-phase star than when used for two phase. For example, if the two-phase winding was grouped in two parallels and was good for 200 volts, regrouping this winding in two-parallel star, three-phase, it would be good for 250 volts. Therefore to make the winding good for the original voltage, 20 per cent of the coils must be left dead. This arrangement will result in a loss in motor capacity of about 15 per cent, and if the full horsepower of the motor is required, then it will be necessary to rewind the motor.

Instead of regrouping the coils for a three-phase winding, 13 per cent of them may be left dead in one phase and the two phases grouped in a Scott connection for three-phase operation. In this connection one of the leads from the phase with the dead coils is connected to

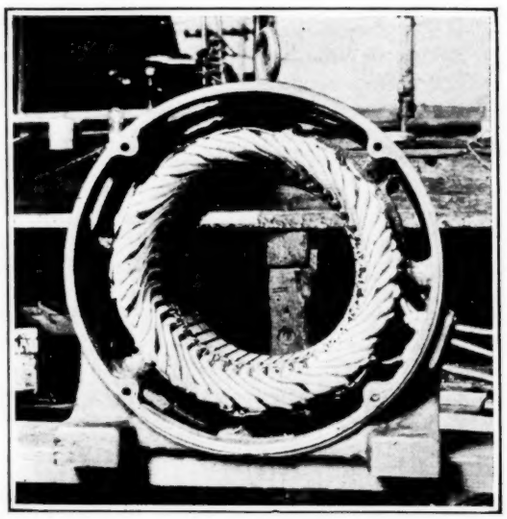


Fig. 4—Stator, Fig. 3, rewound for three phases and six poles

the middle point of the other phase, thus giving a tee connection. It is also possible to use the two-phase winding in a tee connection for three-phase operation without leaving any of the coils dead. But this should only be done as a temporary measure, since the connection does not give a balance winding. In other words, it acts as a three-phase winding with more turns in two of the phases than in the other one. This will result in a lowering of the efficiency, power factor and torque of the motor. Where a large number of two-phase motors are to be supplied from a three-phase system, it may be good practice to install Scott connected transformers and change the three-phase power into two-phase, rather than rewind the motors.

The speed of a compound motor cannot be adjusted by introducing a variable resistance in the shunt-field winding, and operate as a compound machine, as with a shunt motor. This is due to the ampere-turns of the series winding becoming more effective as the ampere-turns of the shunt winding are reduced. Where a drive requires a compound motor during the starting period and shunt-field control after, the series winding is cut out of circuit before introducing resistance into the shunt-field circuit. Such conditions are found in elevator and printing-press drives, etc.

In order to perform its function properly two things are essential in the brick setting of a boiler: It must be tight so that the air will be forced through the fuel bed and come in contact with the combustibles. It must also force the heated gases to travel in the paths laid out by the boilermakers so that the heat may be absorbed by the water in the boiler.

Experience with Diesel Engines in a Kansas Flour Mill*

By CHARLES DALRYMPLE†

IN THE development of the flour-mill industry power has played an important part, inasmuch as the chief manufacturing expense is that of the power to operate the machinery.

The early mills, with their crude stones, were situated on the rivers where water was available to turn the mill wheels. This was by no means ideal, for the power often failed during high water or drought and the sites were often located far from the railroad connections and from wheat markets. For these reasons the flour mills were quick to take up the Corliss steam engine, and during the days of cheap fuel it furnished a satisfactory source of power.

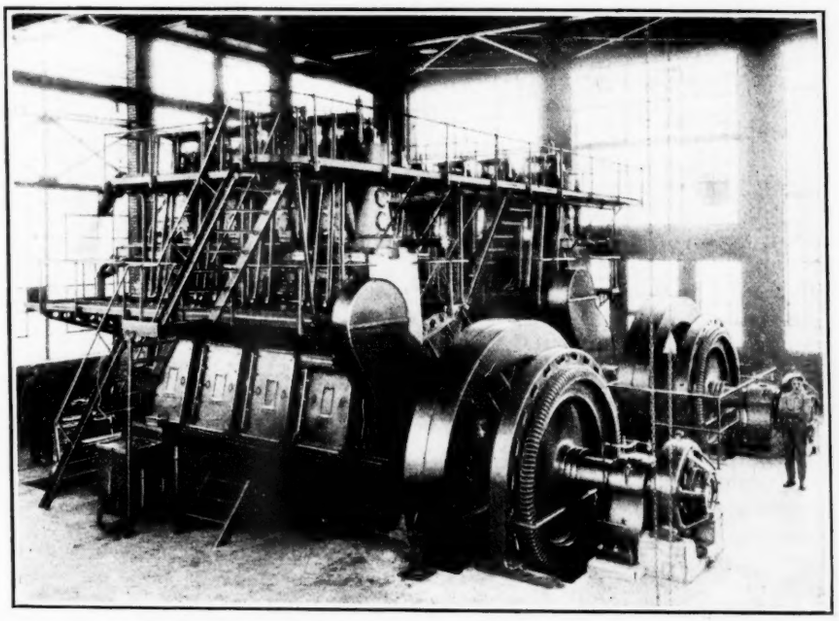
The last twenty years have seen the development of flour mills from a capacity of two or three hundred barrels a day to units of several thousand barrels capacity. At the same time we have seen the cost of fuel more than doubled, and it was necessary to look for cheaper power, while maintaining dependability.

Very few steam engines have been installed in the newer flour mills, although a few steam turbines have been purchased; for the most part power has been furnished either by Diesel engines or by purchased current.

Electric power, while it is ideal for many manufacturing processes, has not always been satisfactory to the flour mills, owing, chiefly, to minor line disturbances that have a habit of coming when least expected. A flour mill must operate as a unit. Every machine is connected through spouting to some other machine, and if any part fails to operate at the correct speed or if the plant as a whole slows down or stops for only a moment, it is usually necessary to shut the whole plant down until the machine and spouting can be cleared of choke-ups. This, of course, entails not only considerably loss of time but damage to the stock.

Those who are familiar with the care and skill required to get the many machines of a flour mill adjusted to produce the exact results required, will appreciate the loss when everything is upset by the flicker of the electric current. These disturbances may be due to a variety of causes—lightning flashes somewhere out along the line, the wind blows a tree across the wires or a lightning arrester breaks down. None of these is serious and bothers no one except the miller, to whom each little disturbance represents a small tragedy.

To make it all the more interesting, these disturbances come most often during the summer months, when the mills are expected to turn out their maximum capacity. Experiences like these have a tendency to build up a prejudice among the millers against purchased power. It is true that some of the disturbances could have been avoided, had the transmission lines been equipped with automatic switches, so as to isolate the trouble without killing the lines, but the building of transmission lines and larger power stations has kept the power companies very busy and they considered that the service was pretty good anyway.



Two 750-hp. McIntosh & Seymour Diesels in Red Star plant

In 1922 the Red Star Milling Co. decided to build a new power plant at Wichita to furnish electric current for two of the mills which for several years had been operating on purchased power. About a year was consumed investigating and collecting data on the performance of the different isolated plants, especially those in flour mills.

We found that the Diesel engine seemed to be well adapted to the requirements of the flour-mill service as to dependability and economy of operation. Although the investment was slightly higher than for a steam-turbine plant, yet the lower operating costs of the Diesel more than offset the higher investment. Another advantage in favor of the Diesel was the much smaller amount of cooling water required.

During the spring of 1923 plans were drawn for a

*Paper presented during Oil Engine Week at the Kansas City, Mo., meeting.

†Chief engineer, Red Star Milling Co., Wichita, Kan.

new plant consisting of two 750-hp. engines direct connected to 625-kva. generators. This plant was designed to furnish power for two mill units of 2,200 and 1,000 bbl., respectively, or a total capacity of 3,200 bbl. daily.

This plant was put in operation on Jan. 1, 1924, and the performance has been satisfactory in every way. When the grain elevators are in operation the load ranges from 950 to 1,050 kw., making a load of more than 85 per cent of the rating of the engines. Through the use of synchronous motors, the power factor is well above 90 per cent. For the last ten months there has not been a moment's delay from the failure of power, not a shutdown nor a lightening of the load at any time due to engine trouble. The speed has been so uniform that choke-ups in the mills have been practically eliminated. Much of this time the plant has operated at practically full load, with no spare engine. Of course we have given these machines careful attention by trained Diesel engine men and did not make the mistake of putting the same crew that had operated the steam plant successfully in charge of the Diesels. Had we followed that practice, perhaps our power experience might not have been so satisfactory.

Any Oil Is Satisfactory

The fuel oil available for our plant has been of various densities and grades, the gravity ranging from 28 to as low as 18 deg. Bé. Even in warm weather we often find it necessary to apply heat to get the oil thin enough to pump. Specifications for fuel oil were drawn up several times, but the laboratory tests of different cars vary so widely that we have come to the conclusion that anything that looks like oil and can be pumped when heated, can be classed as Diesel fuel.

During the first few months of operating this plant we found that while using what appeared to be an excellent fuel oil particularly free from any sediment or foreign matter, the steel valves in the fuel pump would accumulate a deposit that had a tendency to lift the valves from their seats and cut down the capacity of the pump. A sample of the deposit was sent to the laboratories for examination and was reported as fine salt crystal. After this a sample was taken from each car of fuel oil and tested for sediment, water, viscosity and ash. A determination was also made as to the percentage of salts in the ash. It was found that if the percentage of salt was below a certain point, no deposits formed on the pump valves, even though the oil contained much more sediment and foreign matter than the oil that gave the trouble. Salt in solution with water does not seem to give trouble of this kind.

Laboratory Test of the Oil

Laboratory tests sometimes reveal the presence of water in suspension in the fuel, which would give trouble if no steps were taken to settle the water out. Some samples show a large percentage of carbon residue, which we are told is due to the modern cracking process used by the refineries. No difficulty was experienced in burning this oil except that the strainers needed cleaning oftener and the fuel spray nozzles required attention at shorter intervals.

The decision to install this plant was made with the intention to secure dependable power of constant voltage, frequency and free from interruptions, rather than with the hope of making any startling savings in the cost of power, as the rates in effect in that locality were not unfavorable. The complete records for the year 1924 show a total net output of 4,354,295 kilowatt-hours with the consumption of 402,917 gal. of fuel oil. This is at the rate of approximately 11 kw.-hr. per gal. All other items of operating cost, including wages, repairs, lubrication and supplies, were $13,642.26, giving a total operating cost of 6.16 mills per kilowatt-hour as the average for the year. This leaves a margin below the cost of purchased power for interest, depreciation and taxes more than sufficient to justify the investment.

Comments on Boiler Tubes

By J. D. Noonan

OWING to their greater safety seamless steel tubes are desirable for high-pressure water-tube boilers; failures are less frequent and, in the event of rupture, usually less disastrous, for a failure in a lap-welded tube would probably extend some distance along the weld.

In industrial plants, where pressures range from 100 to 200 lb. per sq.in., the lap-welded steel tube is the most widely used because it is the cheapest. While the charcoal-iron tube is tougher and may stand more rolling, its principal advantage is its ability to resist corrosion. Where the feed water has corrosive tendencies, charcoal-iron tubes are recommended for fire-tube boilers. The cost of a 72-in. by 18-ft. horizontal tubular boiler is increased about 20 per cent when charcoal-iron tubes are specified; the cost would therefore be considered, and in the case of retubing, the remaining life of the boiler proper would also be a factor.

Holding Power of Tube Ends

Much has been said about the holding power of tube ends. A rolled joint may be made that will offer a resistance beyond the elastic limit of the tube and remain tight. I have seen several boilers, the upper segments of which were severely bulged, whereas the tube area of the heads showed no distortions and there was no evidence of leakage at the tube ends. The distorted sheets were not due to improper workmanship when installing tubes, but were caused by internal pressure and unknown temperature stresses.

Stay tubes, threaded into the sheet, are not used as extensively as formerly. They were more common at a time when the holding power of the rolled and expanded joint was not accepted as sufficient. After rolling, water tubes are flared; this raises the ultimate holding power but does not alter the original slipping point. It seems evident that the flared portion would have to be moved into the hole before its metal could come into play, and the joint would probably leak after the initial movement of the tube. Fire tubes are usually beaded, except that at the cooler ends they are sometimes flared. Beading is of particular advantage in preserving the tube ends from the fire. Tube-sheet bridge cracks are often started by overrolling, and are found mainly in locomotive and hoisting boilers.

Forge welding short pieces to fire tubes after the ends have been cut off by reason of thinning, has long been practiced and is known as re-ending, piecing and safe-ending. This method of repair is acceptable, but tubes that are re-ended by autogenous welding are not allowed by inspectors. It is quite possible that this latter method of re-ending would be more desirable if faith in the ability and integrity of the welders could

be had. Nevertheless, autogenous re-ending of fire tubes is successfully practiced, and in a number of instances in which fire-tube boilers have been retubed by tubes repaired in that manner, not one failure has come to my attention. It is believed that the strength of the welded joint in the tube may be compared favorably with the tube joint in the sheet. If one may assume that the tensile strength of the tube is reduced 50 per cent by the presence of an autogenously welded re-end, it seems that it is still stronger than the tube joint in the sheet.

Life of Tubes Varies Considerably with Conditions

The life of boiler tubes varies considerably; charcoal iron tubes will usually last from fifteen years to the life of the boiler, while steel tubes in fire-tube boilers have a rough average of five to fifteen years. In locomotive boilers not more than from one to two years is expected of them. The design of most water-tube boilers brings the greatest temperature stresses on a certain few of the tubes. These tubes are frequently replaced on account of small bags or bulges. Many things affect the life of boiler tubes; workmanship in installation, feed-water conditions, kind of fuel, method of firing, care and service, temperature stresses and rate of evaporation are some of them. If water tubes were kept free from scale, the number of replacements would be considerably reduced.

The inspection of tubes is of vital interest. The inspector should have a good light, a scraper and a test hammer. In vertical tubular boilers the upper ends often show early leakage due to forcing, being unprotected until steam forms. The lower ends usually leak because of deposits on the lower tube sheet. If the scale is chipped from the tubes at the lower sheet, some tubes thinned by corrosion may be revealed. In one case a battery of four vertical tubular boilers were found to have the five-year old steel tubes extensively pitted at the water line. Horizontal tubular boiler tubes usually show wear first at the rear heads, and the defects are best detected by hammering the tubes close to the rear head. Very thin tubes in such boilers require renewal, as further rolling will be of no avail, and tubes have often been cut off by excessive rolling. Enlarged and elongated tube holes due to excessive rolling may be found; lap-welded tubes rolled into holes slightly too large may result in cracked tube ends. Bowed tubes and leakage may denote overheating from low water. The rear ends often show leakage resulting from scale deposit on the head. Pitted tubes may be found in any boiler, and the inspector should judge whether the extent of the defect warrants renewal. There is little necessity of recommending the renewal of pitted tubes in heating boilers until the tubes are very thin or unless it is thought the tubes will not last through the next heating season.

Rigid Inspection Desirable

Water tubes should have a very rigid inspection; the rows nearest to the fire frequently contain bulges, and unless the bulge is very light and in a coal-fired boiler, the tube should be ordered replaced. In the furnace it is essential to have the tubes cleaned for inspection, and all tubes should be closely scrutinized for any bulges, traces of leakage, turbine deformations, bows or sags, or any distortions or other defects that may be visible. It is well to feel along the tube with the hand. In the case of oil fuel look for evidence of any improper deflection or impinging of the flame on the tubes and trace the cause. In any other curved-tube types, particularly examine and hammer at the bends. Note any leakage at the ends or any signs of slipping or pulling through the tube holes. The internal surfaces of each tube should be examined; the overheating and bulges on the rows nearest the fire may be caused by a light layer of scale. Passing an extension light into a curved tube might reveal a defect that would otherwise be hidden. In B. & W. type boilers particular attention should be given the mud-drum nipples; in cases of leakage it may not always be due to corroded and thin nipples; the mud drum may not be freely suspended. It should also be seen that the mud drums of Stirling-type boilers are freely suspended, because, if not, tube trouble will probably result. Curved tubes are subject to circumferential cracks at their connections to mud drum. From a moral viewpoint while making the inspection bear in mind that a boiler can become an engine of destruction with attendant loss of life.

The Engineer of Tomorrow

The engineer of tomorrow will be as versed in technology as is the engineer of today, but he will require a keener insight into the trends of engineering science, which is the co-ordination of pure science and economic requirements.

The engineer designing the power station of today already takes into account that ten years from now it will be in parallel with stations designed with the aid of new knowledge in physics, chemistry and mathematics, as well as for the requirements of advancing economic practice.

The machine tool of today not only embodies all the knowledge of present designs, but incorporates the trend of engineering production methods. The further development of the machine tool and its numerous allied types will alike be influenced by the new knowledge gained in the scientific laboratory and by the requirements of the industries demanding better and, at the same time, cheaper production.

The plant management of today will undoubtedly be modified by important developments and researches being made in the field of industrial psychology. The engineers and psychologists are just beginning to get together, and here is being developed a new phase of the management function in engineering science.

It is therefore not sufficient for the engineer of today to know the engineering of today. Even though the acquisition of this knowledge alone calls for a vast amount of application, he must find time to weigh the trends of engineering thought. He must contact with engineers who are thinking about the engineering of tomorrow.

Education, textbooks, technical papers and discussion, are all amply available for the engineer of today, but for him to prepare to become the engineer of tomorrow, he must be able to make a quick and satisfactory appraisal of the ways and means and worthwhileness of doing a thing in any particular way. He must have ready accessibility to the knowledge of pure science and equally to the economic requirements. From these he formulates technological probabilities, co-ordinates them with the management function, and the result is the trend of engineering.—*From recently issued bulletin explaining the professional divisions of the A.S.M.E.*

What Does a Pound of Steam Contain?

A DISCUSSION of the meaning of total heat and external energy shows that the steam tables are based on a constant-pressure process. Nothing fundamentally wrong with these tables.

By L. A. WILSON*

THE point recently was raised that the tables of the properties of steam and ammonia were in error, inasmuch as the energy used in doing external work was included as part of the total heat of the vapor. However, there is nothing fundamentally wrong with these tables, and it is not difficult to explain the significance of *total heat.*

Vapor tables and charts are based on the heat required to generate the vapor, either saturated or superheated, *at constant pressure,* using as a datum point 32 deg. F. of heat energy supplied to the vapor. Conversely, a downward movement of the piston would be accompanied by the conversion of potential mechanical energy into heat, as in any pumping or compressing process. These energy transformations are governed by the First Law of Thermodynamics and the relation 1 B.t.u. = 778 foot-pounds. The total heat absorbed by the substance in the cylinder includes: (1) The *intrinsic energy* stored in the substance itself in the form of sensible heat and the internal latent heat energy, and (2) the *external*

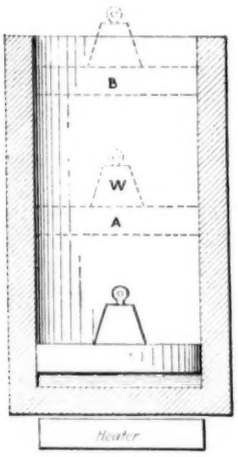


Fig. 1—Effect of heating a fluid at constant pressure

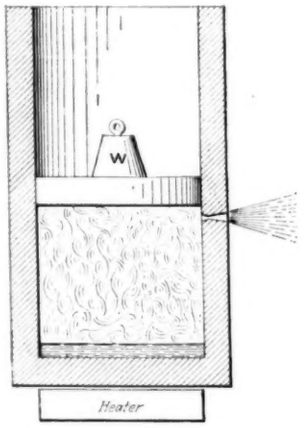


Fig. 2—Constant-pressure steam issuing through nozzle

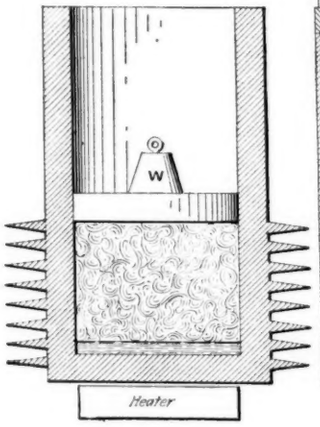


Fig. 3 — Radiation absorbs heat at constant pressure

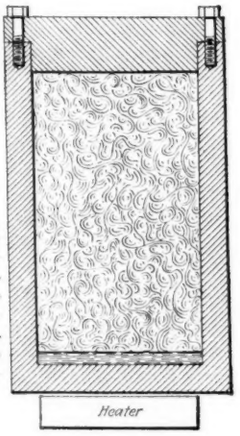


Fig. 4—Heat absorption at constant volume and a varying pressure

To illustrate, suppose the cylinder and weighted piston in Fig. 1 constitute a pressure vessel adapted to vaporize a liquid without any loss of heat by radiation, conduction or convection. The piston is assumed to be frictionless so that the weight of the piston and its load W, augmented by the pressure of the atmosphere, maintains a definite and constant pressure on the substance in the cylinder. Let the heating process start with one pound of liquid at 32 deg. F. First, the temperature of the liquid rises slowly to the boiling point corresponding to the pressure; then the liquid gradually changes to a vapor, and at the same time there is an enormous increase in volume, which results in the weighted piston being lifted to make room for the vapor, as shown at *A*. Finally, after the liquid has been completely converted to the vapor form, further addition of heat superheats the vapor, raising its temperature and causing additional increase in volume. This results in the piston rising to the position shown at *B*.

Any movement of the piston upward is indicative of work being done by the expanding vapor, at the expense of heat energy which is used to lift the weight and which is stored in the elevated mass in potential form. This distribution of the heat supplied can be expressed by the simple energy equation,

$$_1Q_2 = (U_2 - U_1) + {}_1E_2$$

in which $_1Q_2$ denotes the heat absorbed between the initial and final states, $U_2 - U_1$ the change in intrinsic energy, and $_1E_2$ the external energy involved, all in British thermal units. Without friction and radiation, $_1E_2$ is equal to the external energy stored in the weighted piston.

Now we will consider the question, Why is the external energy included in the total heat of the vapor? Refer again to Fig. 1 and imagine that the vapor is still in the superheated state as we left it, that the weighted piston is in an elevated position and maintaining the pressure constant, and that the heater is supplanted by a cake of ice. Obviously, the reverse of the original phenomena will occur while heat is being transferred from the vapor to the ice. First, the superheat will be removed, then the latent heat of vaporization, and finally the heat of the liquid, thus eventually returning the

*Associate Professor, University of Wisconsin.

substance in the cylinder to its initial condition of liquid at 32 deg. F. During the removal of heat from the vapor, the volume will decrease to the same extent that it increased in the first instance, and the heat previously converted into work will thus be returned to the substance as *heat of compression* and will finally be absorbed by the ice. Exactly the same quantity of heat will come out of the substance as was put in; that is, both the intrinsic energy and the external energy are available in a *constant pressure* process, regardless of the fact that the external energy and a large part of the intrinsic energy are associated with the vapor in the potential or latent form. It follows that total heat, or heat content, must be interpreted to mean the heat that goes into the substance to generate vapor *at constant pressure* from liquid at 32 deg., or which comes out of the vapor in changing it at constant pressure to liquid at 32 deg.

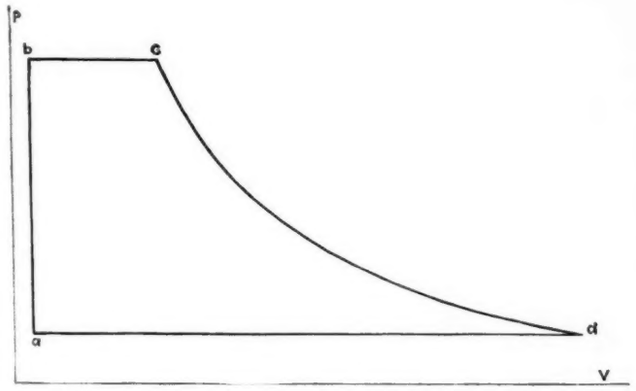


Fig. 5—The Rankine steam cycle

It is immaterial whether the vapor is generated in some special apparatus like that shown in Fig. 1 or generated at constant pressure in a power-plant boiler. The pressure in a boiler is kept substantially constant during normal operation by regulating the rate of combustion in the furnace to correspond with the rate at which steam is being withdrawn from the boiler. Reference will now be made to three common methods of disposing of the steam generated in a boiler.

Action in Steam Engine

When the steam is used by a reciprocating engine, say of the slow-speed, double-acting, Corliss type, first one end of the cylinder and then the other is in direct communication with the boiler during the constant-pressure admission period. This case is identical in principle with that illustrated by Fig. 1, the pressure in the boiler being maintained constant by allowing the volume of the steam to increase against external resistance, while maintaining the proper relation between the rate of combustion and the rate of steam consumption. Thus the external energy of the steam is utilized in the engine during the admission period, after which there is a conversion of intrinsic energy into work during expansion.

When the steam is used by a steam turbine, the steam taken from the boiler is led to nozzles where it acquires kinetic energy at the expense of its total heat energy. The nozzles restrict the flow to some extent and enable the proper relation to be established between the rate of steam generation and the rate of consumption so that the pressure in the boiler will remain constant. Fig. 2 shows a modified form of the apparatus of Fig. 1, adapted to maintain a constant pressure during vaporization in a manner similar to that exemplified in a steam-turbine plant.

Use in Steam-Heating System

When the steam is used in a steam-heating system, the heat associated with the steam withdrawn from the boiler is disposed of by radiation and convection instead of converting it to mechanical energy. The same is true in the case of steam discharged to a condenser. A special apparatus differing from that in Fig. 1 only in the addition of extensive cooling surface, is shown in Fig. 3. Imagine that the rate of supplying heat is adjusted to be exactly equal to the rate of cooling, so that the vapor will condense as fast as it forms. Obviously, the pressure will then remain constant during vaporization without affecting the position of the weighted piston.

The outstanding difference between the cases cited herein is the method of disposing of the energy supplied in the form of heat during vaporization. It will be observed that the same constant pressure obtains in all these cases. It is a self-evident fact that the quantity of heat required to generate a pound of vapor depends only on the pressure at the surface of the liquid and is not affected in the least by what happens to the vapor subsequent to its formation so long as the pressure in the boiler remains constant.

Although in nearly all practical applications vaporization and condensation take place substantially at constant pressure, constant volume addition or rejection of heat is of interest primarily in connection with certain ideal vapor cycles. To illustrate the principles involved in cases of this character, the formation of vapor under constant-volume conditions will be described briefly, with reference to the special apparatus shown in Fig. 4. Addition of heat to the liquid in the bottom of the vessel converts the liquid to vapor, gradually increasing the pressure but not changing the total volume. It is obvious that no heat is converted into external work in this case, therefore the total heat required to effect vaporization at constant volume is less than that required at constant pressure. In fact, only the intrinsic energy is involved in a constant-volume process. This is verified by putting ${}_1E_2 = O$ in the simple energy equation, making ${}_1Q_2 = (U_2 - U_1)$, the change in intrinsic energy.

Action in Special Cases

In some cases conditions may be such that both the volume and the pressure seem to be constant. This is true of the special process described with reference to Fig. 3, but there the volume is constant only by virtue of a special condition imposed whereby the rate of cooling is just equal to the rate of supplying heat to the liquid. In that case the governing factor is the *constant pressure*, for if the special balancing condition ceased to hold, the pressure would still be maintained constant by the weighted piston, entirely independently of the rates of supplying and rejecting heat. The steam-heating system is fundamentally the same in principle; that is, the pressure is substantially constant during normal operation, and any increase in pressure above normal would result in steam flowing out of the safety valve to assist the radiating surface in maintaining constant pressure. A constant-volume process, strictly

speaking, is one during which the volume is invariable, under all possible conditions, between the limits of the process.

The ideal, elementary power-plant cycle, illustrated in Fig. 5, is developed in the following manner: A pound of condensate, at the temperature of the exhaust, is pumped into the boiler and heated to the boiling point at boiler pressure. This process is represented by the line *ab* and the heat absorbed by the liquid is $q_b - q_a$, where q_a and q_b are respectively the heat in the liquid at state *a* and *b*. The liquid is then converted into vapor at constant pressure, as indicated by *bc*, the pressure being maintained constant by allowing the volume to increase against the resistance offered by the heat motor. Under ideal conditions friction and radiation losses do not exist, so the external energy of vaporization, and the work done in the heat motor during the process *bc* are the same. If there is a superheater between the boiler and the heat motor, the vapor will be in the superheated state at point *c*; otherwise the vapor will be in a saturated condition. If H_c denotes the total heat of vapor corresponding to conditions at *c*, the heat supplied along the path *abc* is $(H_c - q_a)$. At *c* the admission valve of the engine closes and temporarily shuts off communication with the boiler. The line *cd* represents adiabatic expansion of the vapor trapped in the cylinder, during which no additional heat is supplied and work is done at the expense of the intrinsic energy in the vapor. The constant pressure line *da* represents the return stroke of the piston during which the vapor is pumped into the condenser at the reduced pressure and enough heat removed by the cooling water to reduce the vapor to the liquid state at *a*. Inasmuch as the last process takes place at constant pressure, maintained by the pumping action of the engine at the expense of energy stored in the flywheel, the external energy of the vapor at exhaust pressure becomes reinstated during the decrease in volume, and the heat rejected along *da* is equal to $(H_d - q_a)$.

Relation of Work and Heat

According to the First Law of Thermodynamics, the work done during any thermodynamic cycle is equal to 778 times the difference between the heat supplied and the heat rejected. For the Rankine cycle then,

Work per lb. of vapor $= 778\ [(H_c - q_a) - (H_d - q_a)\ ]$
$= 778\ (H_c - H_d)$ foot-pounds

where H_c and H_d are the total heats above 32 deg. F. corresponding to the conditions at the beginning and end of the adibatic expansion. This cycle, reversed, is the basic cycle of vapor-compression refrigeration plants.

In conclusion, the following fundamental facts must not be ignored when using vapor tables and diagrams:

External energy is associated with every *constant pressure* process, either in the form of mechanical energy or as dissipated heat and may be expressed as,

$$_1E_2 = \frac{P(V_2 - V_1)}{778}$$

There is no external energy associated with a *constant volume* process. The heat added or rejected at constant volume is equal to the change in intrinsic energy.

When the pressure and the volume of the vapor vary simultaneously, the simple energy equation is valid, but the temperature-entropy diagram usually gives the desired results more directly. The ideal isothermal and adiabatic processes come within this class. The heat added or rejected during an isothermal volume change is equal to the product of the absolute temperature and the change in entropy, as represented by the area under the isothermal line on the temperature-entropy plane. In an adiabatic process, since no heat is added or rejected except in the form of work, the work done in ft. lb. is 778 times the B.t.u. change in intrinsic energy, and the condition of the vapor at any point in the process can be determined from the temperature-entropy chart by following a constant entropy line.

The heat converted into work per pound of vapor in an ideal Rankine complete-expansion cycle is equal to the difference between the total heats at the beginning and end of the adiabatic expansion. These values may be read directly from the Mollier diagram.

Fuel Preparation for Chain-Grate Stokers

By F. C. Duennes*

Fuel preparation involves two distinct operations, sizing and wetting. Of the two the sizing is the more important although considerable loss may occur if the fuel contains insufficient or too much moisture. The required moisture is usually added after the coal

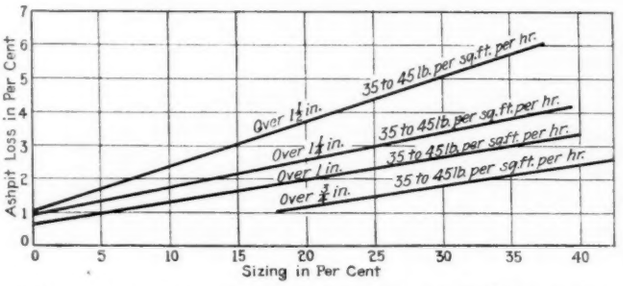


Fig. 1—Showing effects of coal sizing and burning rate on ashpit loss

has been sized properly and is on its way to the bunkers. The amount to be added has been found to be best determined at the time of wetting on account of the variation in sizing that will occur when different kinds of coal are being crushed.

Water is added primarily to aid combustion, although it also settles the coal dust. Upon entering the heated furnace, the moisture vaporizing rapidly agitates the fuel bed, thus preventing it from caking over on the surface and not permitting the coal underneath to burn out completely. If too little water is added, the coal will cake over on the surface of the fuel bed; and if too much is added, delayed ignition will result due to the reduction in furnace temperature at the ignition point.

TABLE I—CRUSHING TEST ON SOUTHERN ILLINOIS LUMP COAL

	Pounds	Per Cent
Sizing over 1½ in.	7.0	2.60
Sizing over 1¼ in.	8.0	2.90
Sizing over 1 in.	14.0	5.20
Sizing over ¾ in.	28.0	10.40
Sizing over ½ in.	48.0	17.80
Sizing over ¾ in.	32.0	11.90
Sizing over ¼ in.	53.0	19.60
Sizing under ¼ in.	80.0	29.60
	270.0	100.00

*Assistant boiler-room engineer, Northwest Station, Commonwealth Edison Co., Chicago.

The operation of reducing the incoming coal to the proper size is an important detail. The coal is received from the mines in a variation of five sizes; namely, lump, egg, nut, mine run and screenings, mine run being an aggregation of the other four. A coal breaker or crusher is the means employed to reduce the incoming coal to the proper size, and the governing factor as to the proper sizing of the fuel is the ashpit loss.

The curves of Fig. 1 were plotted from data obtained from a large number of evaporation tests performed on

At Quarry Street Station the ring type of coal crusher has been giving results close to the desired sizing. Recently, two crushers of the same type were installed at Fisk Street Station. The results of a coal-sizing test recently performed on one of the new crushers at Fisk Street Station are given in Table I.

Another test conducted previously at the same station and summarized in Table II, gave results with mine-run coal closely approximating those of Table I. The amount of fines below ¼ in., including the fines

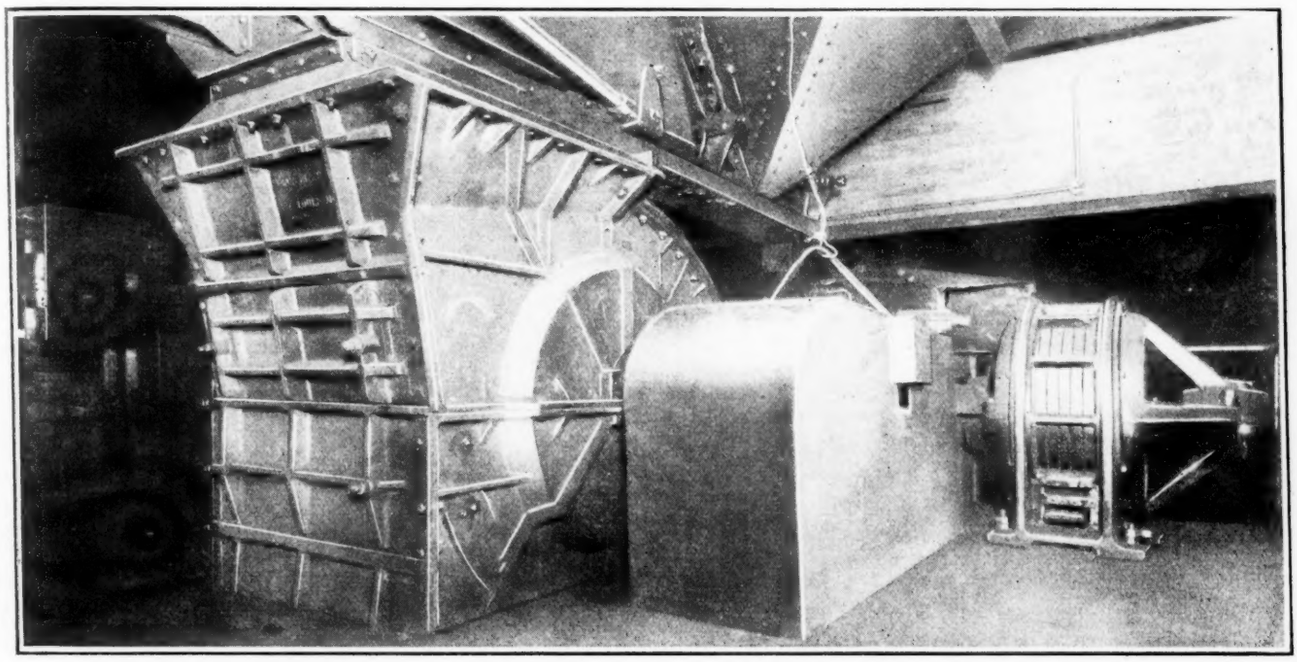


Fig. 2—Ring-type crusher at Fisk Street Station; rotor 61 in. diameter, 42 in. wide; capacity, 180 tons per hour

our large boiler installations to show the effect of the sizing of coal on ashpit losses. At the same fuel consumption rate it will be seen that the tendency is toward higher ashpit loss as the coal is coarser. The effect of coarse coal toward higher ashpit losses is proportional also to the rate of fuel consumption. This means that with the same sizing of coal, burning at different rates, the tendency is for the higher rate of fuel consumption to result in higher ashpit losses. The burning of coarse coal may introduce another loss if the firing is incompetent, that of excess air through the fuel bed. But this loss can be controlled within limits by proper manipulation of the air supply.

TABLE II—CRUSHING TEST WITH SOUTHERN ILLINOIS MINE-RUN COAL

	Per Cent
Sizing over 1½ in.	0.49
Sizing over 1¼ in.	1.47
Sizing over 1 in.	5.30
Sizing over ¾ in.	15.28
Sizing over ½ in.	15.20
Sizing over ⅜ in.	10.30
Sizing over ¼ in.	22.06
Sizing under ¼ in.	29.90
Power consumption	53 hp.
Tonnage crushed per hour	130
Power consumption without load	22.5 to 27 hp.
Crusher capacity	180 tons per hour
Motor	75-hp., 3-ph., 220-v., induction

A comparison of these curves would indicate that the critical size is less than 1 in., but in the attempt to crush all the coal to ¾ in., the percentage of fine coal, that is, coal below the ¼-in. size, is much increased. This is objectionable.

already in the coal before crushing, is only 29.90 per cent, and the coarse sizing over 1 in. aggregates less than 8 per cent.

Every substance expands and contracts under changes in temperature. In each 180 deg. F. iron changes one part in 800 approximately, while firebrick changes only one part in 2,000. The result is that when the boiler is fired, the ironwork expands more than the brickwork, which is slightly moved when the iron expands. When the boiler cools and the ironwork shrinks, the brickwork stays where it was pushed, and the process is repeated when the boiler is fired again. Cracks are developed in this manner, and inasmuch as these conditions continue as long as the boilers are in service, it is necessary that the engineer be continually on the watch to keep the settings tight.

Ammonia joints should never be broken in a hurry and never without having first provided an opportunity for escape in case the fumes should become excessive. Loosen up each just a little and then gradually work the joint open with a chisel or other device. If then there is pressure on the joint, there is at least plenty of time to get away, and generally it can be tightened up again before the fumes become dangerous. It is always advisable to use a gas mask or a towel saturated with vinegar.

Subterranean Heat as a Source of Energy

METROPOLITAN Section, A.S.M.E., devotes evening to symposium on possibilities and accomplishments to date in the utilization of subterranean steam.

Flank eruption of Etna in 1910

IN OPENING the meeting[1] John W. Lieb, the chairman, pointed out that all past civilizations have been based on man's own muscular energy assisted in some slight degree by the energy obtained from domesticated animals. Present-day civilization, however, is due almost entirely to external energy created by the utilization of natural resources developed by natural powers, water or wind power, or the stored energy of oil or coal. Our steam and internal-combustion engines use heat from the solid and liquid fuels that have been stored in the crust of the earth during past geologic time. Our wind and hydraulic engines use natural sources of energy produced in our own time by the bountiful heat given out by the sun.

Cone formed in crater of Vesuvius

The profession has met the demands for efficiency by reducing in 35 years the use of heat necessary to energy production from 150,000 B.t.u. per kilowatt-hour to less than 20,000 B.t.u. And now 15,000 is here and even 10,000 B.t.u. is considered to be within the possibilities. But even this will not suffice. Our coal and oil supplies will still be depleted, although the ultimate end may be put off to ten or twenty milleniums.

And meanwhile in both Europe and America the developments of a new natural resource, a source of natural heat, have been conceived. constructed and put into actual operation. To Prince Ginori Conti belongs the honor of having first made a practical application in 1904 of this interesting natural resource by undertaking a power development among the fumaroles. solfatare and soffioni of Larderello, 75 miles southwest from Florence, where in 1827 Larderel started his borax recovery works.

Volcanism as Sources of Power

By Frank A. Perret, K.I.C.

BELOW the cooled, habitable surface of the world, matter exists at high temperature, and this comes to the surface in various localities. These regions are situated in countries which, geologically speaking, are of recent formation, where true volcanic activity is still going on, or where large batholithic intrusions have reached sufficiently near to the surface to make their presence known through vapor perforations or hot-water manifestations. For the purposes of our present study, I shall make three principal distinctions between these surface manifestations: The true volcano; the solfatara; and the geyser region.

The true volcano is a vent of such size and permanence as to have continued activity for a period of time, which has generally built up a mountain of the erupted materials around the vent. These materials (other than the volatile constituents) are lava and its derivatives.

[1] Held at the Engineering Societies Building, New York, Nov. 12, 1925.

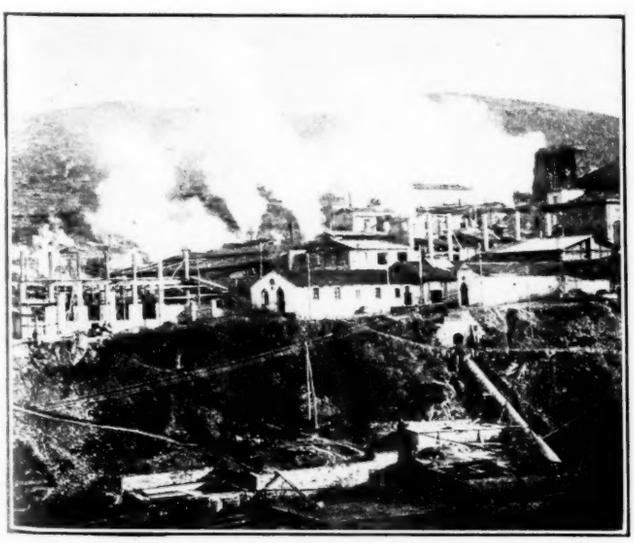
The solfatara is a region of far more moderate activity which has formed upon a true volcano, either as a result of this having become semi-extinct, or of some side or portion of it becoming so. The materials emitted are water vapor, volcanic gases, or hot water, accompanied by sulphur and other low-temperature volcanic products.

The geyser region forms where a great subterranean mass of igneous magma has intruded, but never reached to surface to form a true volcano. If water exists in great abundance in the overlying terrane, geysers usually form, whereas if this is in lesser quantity, there may be, instead, the so-called "soffioni"—jets of steam containing more or less gas and chemical substances according to the nature of the contacts.

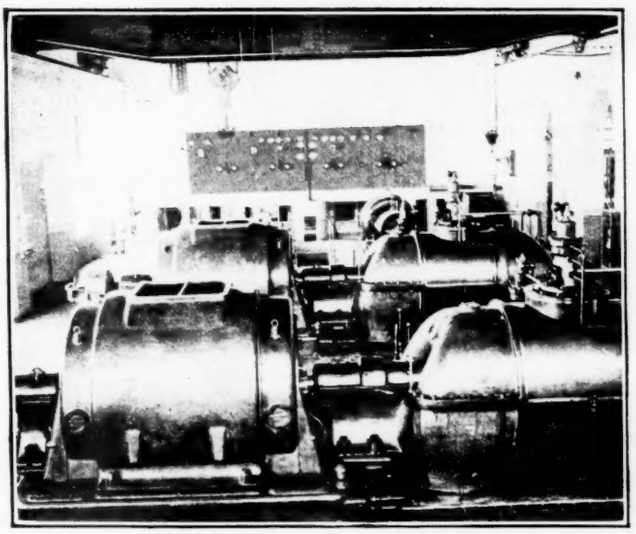
One outstanding characteristic of the true volcano is its supreme unreliability. At one moment—that is to say, for some hours, weeks or months—it will release an amount of energy which not only is incalculably great, but which, in its unfolding, involves, spatially and dynamically, practically the entire volcanic edifice. At Vesuvius during the culmination of the last eruption, in 1906, I observed great nodules of vapor expanding outwardly with incredible velocity, after having been projected nine miles above the crater. The mountain itself is four thousand feet high. This continued unabated for a period of twelve hours. After this the volcano slept for seven years.

Instead of the main eruption occurring through the central conduit, this may take place upon the flank of the volcano. Etna rises to a height of nearly eleven thousand feet, and its base has a circumference of ninety miles. Any portion of this great area may open and give rise to an eruption of fluent lava, as shown in the accompanying photograph taken from the outbreak of 1910, on the southern flank.

It is the third type of surface manifestation that provides the most nearly ideal source of available energy. The geyser region offers the most reliably constant supply of useful heat, brought to the surface or available to comparatively shallow borings, in the form of vapor. The actual source of the heat is a subterranean intruded mass of igneous material, generally very great in volume, whose temperature is maintained not only by poor conductivity of contact walls, but by its slow crystallization with consequent exothermic reaction. It is this type of geopyric manifestation which, so far, has been found of real practical utility.



General view of Larderello works



Turbine room at Larderello

We have shown the enormous but erratic power of the true volcano, the lesser and more nearly constant output of the solfatara, and the mild but practically uniform exhalation of heat in the geyser region. Beginning at the simplest and safest source of energy, there is no reason why we may not utilize, in time, even the greatest of these, and the work of the world be done by the energy of its own specific heat.

Natural Steam at Larderello

BY PROF. L. P. BRECKENRIDGE

ONE day last summer at Florence I received a cable from Mr. Lieb, advising me to visit the natural steam power plant at Larderello. Upon approaching Larderello my first thought was a steel plant—so much steam streaming up from a hundred spots for a half mile along the valley, but not a bit of smoke, just steam and groups of many buildings—evaporating sheds, storehouses, homes for workmen, and general office headquarters.

When the steam and gas, in finding their way to the surface, bubble up through craters filled with water these peculiar formations are called *Lagoni*. It was early discovered (Höfer, 1777) that the steam when condensed carries a small percentage (0.1 to 0.3) of boric acid, and in 1827 Francesco Larderel ingeniously conceived the idea of using the natural steam itself to concentrate the weak solution of boric acid.

While much careful study had been made concerning the character and quality of the steam from different locations and from wells of different depths, it was not until 1904 that any attempt was made to use the steam for power purposes.

The success of the first experiment with a small steam engine soon led, in 1905, to a second one using a larger steam cylinder with the object of learning the effect of the steam on the metal surfaces. This engine stood the test bravely, and for over 15 years worked day and night practically without any hitch, giving about 15 hp. and driving a dynamo.

It was but a natural step to install at Larderello in 1912 a turbo alternator of 250 kw. capacity.

More power for industries and transportation was badly needed during the Great War, and no effort or expense was spared to add to the capacity of this plant and tie it in with the main electric lines of Tuscany, so that by the beginning of 1916 new wells had been drilled, a supply of steam of 260,000 lb. per hour was under control, and the first of the three new units of 2,500 kw. was in operation. This also involved the building of two large cooling towers for the condensing water, as well as the installation of 22 evaporators, because up to 1923 the natural steam was not used directly in the turbines, but was used to evaporate pure water for the turbines, to avoid large quantities of

A natural spring of steam at Larderello

objectional gases in the surface condensers and corrosion of the turbine blades.

The plant as described was in satisfactory operation from 1916 to 1923, at least natural steam drawn from the earth produced electricity, but difficulties arose and new problems presented themselves as time produced unlooked for effects.

Research was apparently an important part of Prince Conti's organization, and after four years of "study and experiment" in another plant installed for the purpose, important discoveries made it evident that changes in the plant (1923) would be justified. In his paper before the World Power Conference Prince Conti says:

> Since 1923 the evaporators have been abolished and an entirely novel manner of dealing with the natural steam has been adopted as the result of an extremely simple but ingenious apparatus invented by my collaborator, Signor Bringhenti, by means of which it is possible to extract from the natural steam about 90 per cent of the gases which are contained in it. The result obtained is steam at a slightly lower temperature, but containing only 10 per cent of the original amount of gas.

The depths of the steam wells at Larderello range from 200 to 400 ft.; in some instances a depth of 500 ft. has been attained before provoking the explosion. So far there has been no shortage of steam.

Heat-Rich Areas of the United States

By George Otis Smith
Director, U. S. Geological Survey

THIS earth is a mass of highly heated rigid rock, and for the present purpose the several hypotheses as to the origin of the internal heat need not be considered. The fact of subterranean heat is the engineer's starting point. To this he needs to add some appreciation of the outer insulating shell that limits the loss of the earth's internal heat. The material making up this insulating cover is only about half as good in nonconducting properties as loose asbestos, but its thickness is such that physicists figure the loss of heat by the whole body of the earth as less than a degree in a million years, or, measuring this loss of heat by a time interval, the quantity of heat escaping each year from the surface of the earth is just about sufficient to melt in that time a film of ice one-eighth of an inch thick.

The effectiveness of this insulation varies much in different parts of the United States. The average rate of rise of temperature with increase in depth usually given in textbooks is 1 deg. F. in every 50 to 60 ft., and this temperature gradient ranges from 19 ft. to the degree at Lost Soldier, Wyoming, or 21 ft. at Thermopolis, in the same state, to 171 ft. to the degree at Franklin Furnace, N. J. As an example of the contrast between such areas in the United States, the temperature of boiling water could not be expected in the Lake Superior copper region short of 20,000 ft., but it was actually reached at the Longmont, Colo., well at about 6,600 ft.; or to come nearer home, the Franklin Furnace well—with a temperature of only 66 deg. F. at 2,500 ft.—would need to be deepened nearly 5 miles to reach the temperature of boiling water. The Franklin Furnace locality, in spite of its name, is not indicated as a heat-rich area.

The practical problem is not whether the earth is hot enough to constitute a supply of energy but to what extent this heat can be made available. The controlling factor is the transfer of heat to the outlet point, whether that be a natural spring or the bottom of the deepest borehole. The task of the engineer in harnessing this very old source of energy will not be as easy as the newspaper headlines will doubtless make it and so the foe will be worthy of his steel.

California Steam Wells

By J. D. Galloway
Consulting Engineer

THE Geysers are about seventy-five miles due north of San Francisco in Sonoma County. They are situated in a narrow canyon at an elevation of about 1,450 ft. The volcanic activity consists of boiling springs and steam jets or fumaroles, where steam escapes directly into the air. There are no geysers in the region; the term being misapplied to the hot springs and fumaroles.

The first work of developing steam for the generation of power was done by J. D. Grant in 1921. Drilling of

well No. 1 was begun in 1922 and well No. 2 in October, 1922. It was completed to a depth of 320 ft. July 20, 1923. Well No. 3 was started and in the summer of 1924 was down 150 ft. when work was stopped.

The information obtained from the first two wells was sufficient to warrant the drilling of more wells, and during the first seven months of 1925 four more wells were drilled. These are distributed over an area about 550 ft. long. An open hole is first drilled through the overburden and into rock as far as possible. Into this hole a 10-in. wrought-steel casing is set and the space between casing and the walls of the hole filled with portland cement grout. After the cement is set, the hole is drilled deeper into the rock until the flow of steam is good and then an inside 8-in. wrought-steel casing inserted and the space between the two casings is filled with cement grout, which is allowed to set. After this the well is drilled as an open hole, deeper into the ground.

The successful results of these wells led to the plans of drilling larger ones. A larger drilling was purchased and well No. 8, now being drilled, has a 15-in. outside casing and a 12-in. inside casing.

In drilling the wells, the incoming steam is condensed by the stream of cold water pumped down to the bottom of the well through the interior hole of the drill stem. The water is sent down under pressures up to 250 lb. per sq.in. and under the pressure rises to the top of the well outside the drill stem and flows off through a side vent. A point is reached when the cold water sent down comes back heated to near the boiling point and this indicates about the depth required. All openings on the well are then closed and the drill is removed. When all is clear, a valve at the top is opened and the hot water is blown from the well by the geyser effect. Rocks and dust are also blown out and it takes a week or so before the well clears the passages.

Characteristics of the Steam

The steam pressure, wells closed, varies and the same is true of the quantity of steam discharged under different pressures. In the case of wells Nos. 6 and 7, they have not been closed long enough to indicate the maximum pressure, but it is believed that it will reach 300 lb. to the square inch.

PRESSURES IN WELLS

	No. 1 Lb.	No. 2 Lb.	No. 4 Lb.	No. 5 Lb.	No. 6 Lb.	No. 7 Lb.
Initial static pressure	64	67	82	143	240	198
Static pressure, September	67.5	67.5	107	211	276	...

With a water rate of 27.5 lb. per kw.-hr., condensing, these four wells represent a switchboard delivery of 4,500 kw., after allowing 10 per cent losses in steam in transmission. Each well on the average will thus deliver about 1,000 kw.

There are numerous gases in the surface strata, but the steam from the wells shows a smaller percentage of gases than at Larderello.

The problem of developing a steam plant at the Geysers has been considered and estimates prepared for condensing and non-condensing plants. If a condensing plant is used, cooling towers are necessary. There seems to be no doubt that the problem presented by the non-condensible gases can be solved. The development of steam at high pressures from the ground by wells is an unqualified success and the extent of the territory gives promise of a large development.

Thermic Calculation of Subterranean Heat

By George A. Orrok

KELVIN, years ago, figured the period between the cooling of the earth's surface from 212 deg. to the present mean temperature of 53 deg., as in excess of 20,000,000 years. Since that time radio-active phenomena have been studied with their attendant heat evolution, and the period has been lengthened from ten to two hundred times. Assuming the specific heat of the magma as 0.2, the heat content of a cubic mile over a range of 3,000 deg. at 10 per cent efficiency amounts to 63,000,000 hp. years and this calculation does not take into account the latent heat of solidification or crystallization of the magma, a quantity amounting to possibly 10 or 15 per cent of the figure given. Nor does it take into account radio-active phenomena.

Kaye & Laby give the total heating effect of radio-active mineral as 300,000 B.t.u. per sec. per cu. mile, or the equivalent of over 400,000 hp. continuously.

Since the time of Humboldt and Bunsen, the average temperature gradient of the earth's crust has been established at about 1 deg. for each 50 to 60 ft. of depth, the variation being from nearly zero in such situations as Larderello and Geyser, to, say, 1 deg. in 200 ft. in the Lake Superior region. Thermic calculations based on the average gradient establish the fact that at 8,500 ft. depth a steam temperature of 212 deg. could be maintained at the surface, and, with a suitable heat transmission surface, a power delivery rising to over 100,000 theoretical horsepower at 25,000 ft. depth. At 150 lb. gage about half of this power could be obtained. Owing to the use of heat and the cooling of the source, the output would be reduced according to a parabolic law until equilibrium is reached at a period involving hundreds of thousands of years. Apparently, the equilibrium value is not far from 25 per cent of the maximum.

Maupertuis in the eighteenth century, and Sir Charles A. Parsons in the last few years, have advocated the sinking of a hole of this kind, and many estimates have been made of the surface necessary to be obtained for power purposes. Herbig, in a late German periodical, gave figures, based on the average temperature gradient, running from 100,000 to 300,000 sq.ft. of heat transmission surface for one horsepower continuously.

Similar calculations for better thermal conditions approaching the ideal might reduce these figures to as low as 257 sq.ft. of heating surface per horsepower. Another writer has called attention to the viscosity of the rock at high pressures and very reasonable temperatures. His calculations show that a 12-in. well 6,000 ft. deep, the lower 3,000 ft. being in a temperature above 212 deg., would furnish only enough heat to displace 200 lb. of good coal per year.

Analysis of the output curves of natural steam wells indicate that the active hypothetical surface of heat transfer is a function of the pounds of steam delivered per hour. This conclusion might seem extraordinary at first sight, but a little thought shows that the volume of subterranean passages drained is a function of the quantity of the steam delivered and hence the active heating surface might be expected to vary with the steam output and, therefore, the steam pressure.

High-Pressure Steam Testing Laboratory At Bridgeport

TWELVE - HUNDRED - POUND boiler and laboratory now in use for testing safety valves, will be available for high-pressure research and development work. Special equipment insures safety, convenience and flexibility.

"HIGHER steam pressures" is the slogan of the hour in the power-plant field. With general appreciation of the fact that considerable fuel can be saved in this manner has come a remarkable advance to 300, 400, 500, 600 and finally 1,200 lb. per sq.in. The last-named pressure is used in the new Weymouth Station of the Edison Electric Illuminating Co. of Boston.

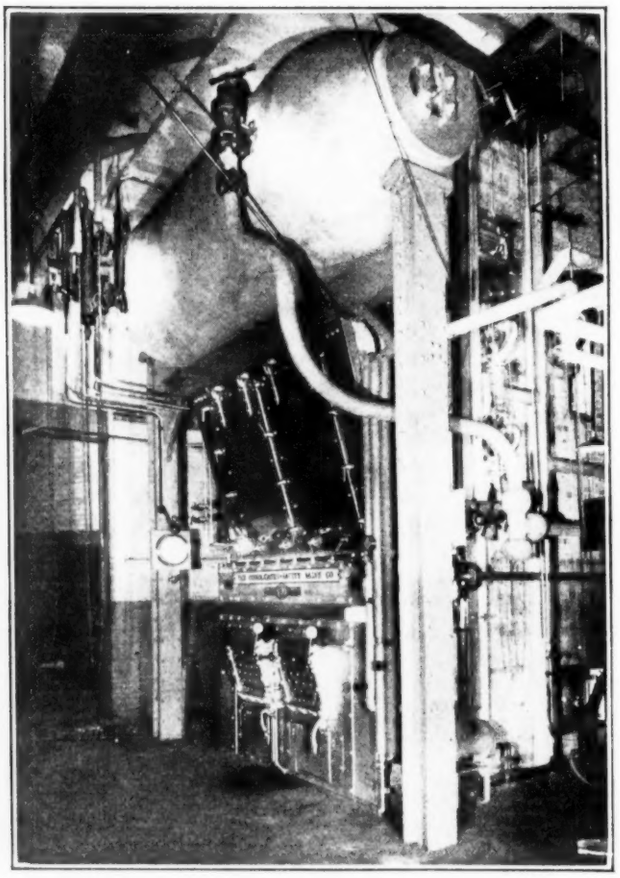


Fig. 1—General view of 1,200-lb.-pressure, oil-fired test boiler

Note water column and gage glasses at left end of drum.

The practical realization of such steam pressures has been greatly accelerated by the initiative of the manufacturers of boilers, turbines, piping and such vital accessories as stop valves, safety valves, water columns, etc.

An outstanding example of such manufacturing enterprise is the high-pressure steam testing laboratory recently completed at the Consolidated Safety Valve Co. Works of Manning, Maxwell & Moore, Inc., in Bridgeport, Conn. In this laboratory safety valves can now be adjusted and tested with actual steam at any desired pressure up to 1,200 lb. and at any temperature from saturation to 800 deg. In addition to its use for valve testing and development, it is planned to use this high-pressure laboratory for general research and development work.

Features of particular interest are the boiler drum forged in a single piece from a 60-ton ingot, the arrangement for testing valves at various pressures and temperatures, the high-pressure accessories such as water column and gage glasses, feed pump, stop valves, blowoff valves, etc. Finally the method of silencing the terrific roar of the high-pressure safety valve "pop" is of interest.

The installation of a 1,200-lb.-pressure boiler in this laboratory anticipated the completion of the Weymouth station[1] and made possible the testing under actual steam conditions of the safety valves for the 1,200-lb. boiler in that plant. The Bridgeport boiler and superheater were specially designed and erected by the Babcock & Wilcox Co., while the Consolidated Safety Valve Co. handled the general engineering work of the installation.

Steel Drum Forged from 60-Ton Ingot

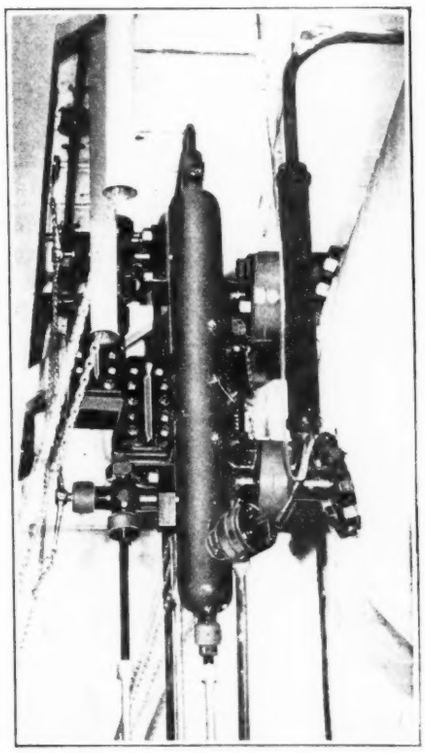
Although similar in design to the Weymouth boiler, the one at Bridgeport is smaller, but with sufficient drum capacity to handle the blow-down of the highest-capacity safety valves it may be called upon to test. Forged in one piece from an ingot weighing 120,000 lb., the drum has a finished weight of 43,435 lb. It is 16 ft. long over-all, has an inside diameter of 48 in. and a minimum wall thickness of four inches. The ends are necked down for the manholes. The arrangement of holes for the circulating tubes (see Fig. 3) increases the resistance of the drum to rupture along a longitudinal plane which is the plane of greatest weakness. With this design and construction there is not the slightest apprehension as to the safety of the drum at 1,200 lb. pressure.

The difficult problem of constructing gage glasses to withstand the 1,200-lb. pressure has been solved as at Weymouth by the use of heavy glass plates inclosed in steel forgings staggered at two levels (see Fig. 2).

The glasses are backed up by mica packing arranged to give clear vision through vertical slots in the steel cover plates. Special local illumination is provided. To supplement the gage glasses provision is made for the attachment of an electrical water-level indicator.

[1]See the April 14, 1925, and Sept. 15, 1925, issues of *Power* for description of the Weymouth installation.

Fig. 2 (Below)—Water column with gage glasses staggered at left



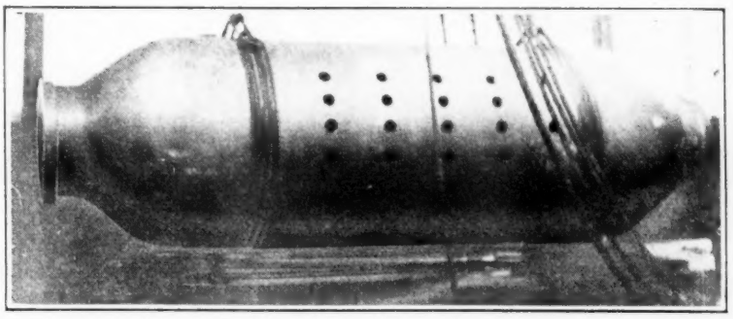


Fig. 3 (Above)—The boiler drum is a single piece of forged steel with a finished weight of 43,435 lb. It is 16 ft. long, 48 in. in diameter and 4-in. thick

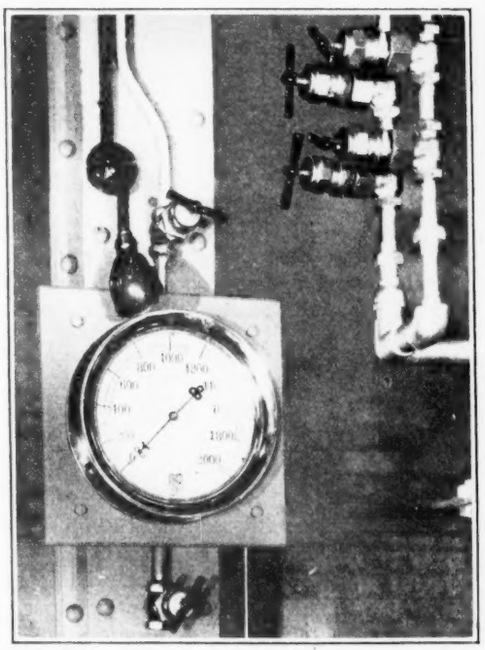
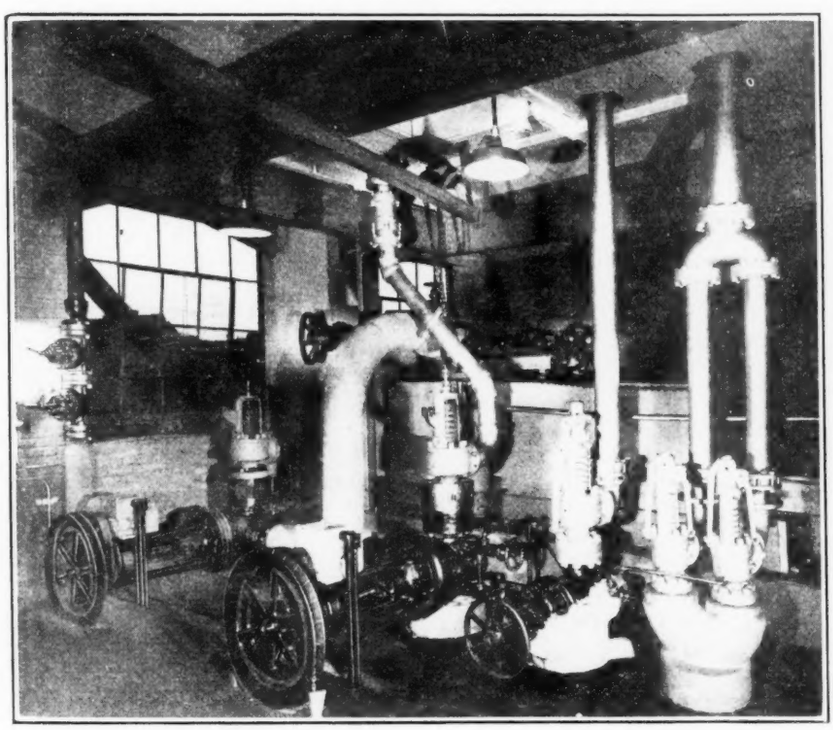


Fig. 4 (Right)—Pressure gage reading to 2,000 lb. Tandem valves are on water-column and water-gage blow-off lines

Fig. 5 (Below)—Testing gallery above boiler showing five nozzles as follows (right to left): First—"Y"-base with two 1,200-lb. safety valves for boiler relief; second — globe cross-valve supplying steam to lower-pressure test drums; third—1,200-lb. saturated steam testing; fourth — connection to superheater inlet; fifth—1,200-lb. superheated steam



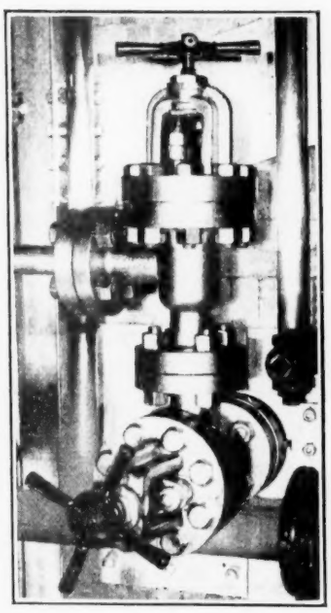


Fig. 6 (Above)—High-pressure steel-body blowoff valves in tandem

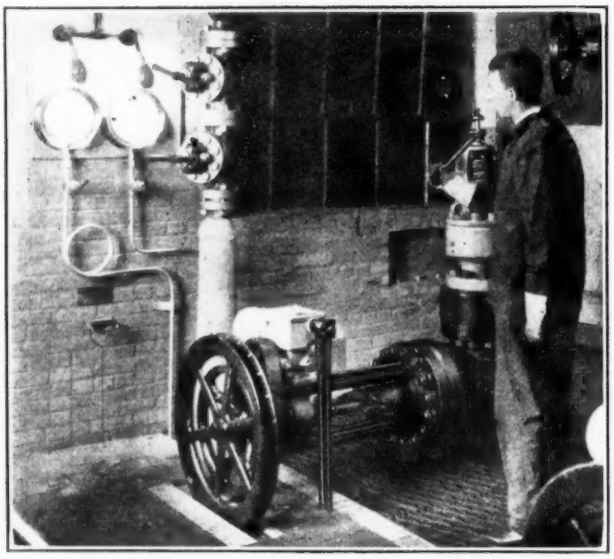


Fig. 7—Testing safety valve with superheated steam at 1,200-lb. pressure

As will be noted by reference to the accompanying photographs, all high-pressure shut-offs, such as those in the water-column and water-gage blowoff lines, main boiler blowoff, superheater drains and bleeders, etc., consist of two steel-body valves installed in tandem.

Oil fuel is used to generate steam. As an emergency safeguard, provision is made for shutting off the oil by a cable running to the testing gallery above the boiler.

One of the novel features of the boiler design is an arrangement that permits varying the steam temperature from saturation to 800 deg. total temperature as desired by manipulating special flue dampers and a stop valve between the drum and superheater.

Feed water is supplied by a simplex steam pump. The feed line is of seamless steel tubing. All joints in this line, including those to the check valves and the stop and check valves are of the Van Stone type with double step joints and gaskets of monel metal. The flange bolts are special alloy steel. All joints on high-pressure connections throughout the installations are of this same type.

Arrangements for Testing

Fig. 5 shows the general arrangement of the testing gallery. All the equipment is above the floor level on the five nozzles shown. The first nozzle in the right foreground carries a Y-base and the two 1,200-lb. form-*DSE* high-pressure safety valves required for the relief of the boiler.

The second nozzle carries a special cross globe valve for supplying steam to lower-pressure testing drums. A form-*DSA* safety valve is mounted on top of this special cross globe valve for the purpose of preventing a pressure above 300 lb. entering this line. The third nozzle is equipped with a special gate valve for testing saturated-steam safety valves.

The fourth nozzle is used for the connecting pipe which carries steam to the superheater, this pipe being equipped with a gate valve. The fifth nozzle is the outlet from the superheater and is equipped with a special gate valve for testing valves under superheated steam. All these gate valves are equipped with bypass valves.

The location of the gallery above the boiler drum, together with the radiation from the necessarily exposed parts, required a special ventilating system. This consists of a blower and exhaust system which displaces the air once a minute, keeping the room at a comfortable temperature, even in hot weather.

Special Features Insure Flexibility, Safety and Comfort

The 1,200-lb. pressure testing units for saturated and superheated steam (third and fifth, respectively, from the right in Fig. 5) are provided with 6-in. gate valves. These are of the non-scraping type and are electrically operated. They can be closed in nineteen seconds against a steam flow of 85,000 lb. per hour.

In case a water gage glass fails, the cocks can be closed from the testing gallery by means of a cable with handle attached. Signals for starting and stopping the oil burners are given from the test gallery by means of an electric horn. In addition a cable and handle are provided for shutting off the oil from the test gallery in an emergency. The extreme flexibility of boiler control greatly facilitates the accurate setting of valves for popping pressure and blowdown.

The pop of a safety valve at 200 lb. pressure is almost explosive in character. At 1,200 lb. the noise is deafening. For the comfort of the operating staff and occupants of neighboring buildings a Maxim silencer (Fig. 8) has been installed on the roof. This silencer (6 ft. in diameter and 10 ft. high) receives the discharge of all regular and test safety valves. Operation is quiet and the back pressure too small to affect the proper setting of the valves.

Acknowledgment is made to C. H. Graesser, works manager of the Ashcroft Manufacturing Co. and the Consolidated Safety Valve Co. (Bridgeport, Conn., works of Manning, Maxwell & Moore, Inc.) for information and photographs used in preparing this article.

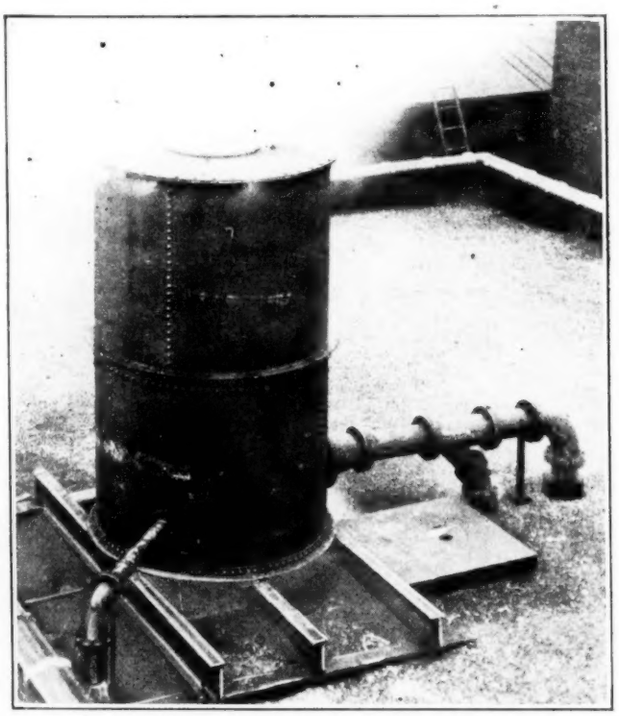


Fig. 8—Silencer handling safety-valve discharge of 60,000 lb. per hour

A High-Pressure Testing Laboratory

HIGH-PRESSURE plants demand "high-pressure" knowledge of those who design and build the apparatus. Great credit is due the manufacturing corporation whose initiative and foresight has recently established a twelve-hundred-pound steam-pressure testing laboratory at Bridgeport, Conn. This is described on page 804.

The considerable sum of money required for the installation of a twelve-hundred-pound boiler of substantial size with all the necessary appliances for operation and testing is probably warranted as a business investment, in view of the fact that one generating station (Weymouth) has already been constructed to operate at this pressure.

This high-pressure workshop should be a powerful instrument of engineering research. Installed primarily for testing high-pressure safety valves, the laboratory will, it is hoped, be made available for the testing of small prime movers and auxiliaries designed for extremely high pressures. So far as is known there are no twelve-hundred-pound boilers in America aside from one at Bridgeport and one at Weymouth.

Special Machinery Is Expensive

RECENTLY, a large mill placed an order for a steam engine to be built along special lines. The duty was not to be at all unusual, and the requirements could have been filled by a standard engine. As it is, the new design calls for probably five thousand dollars' worth of development work, while the contract is for less than twenty-five hundred dollars. In other words, to please some fancy of the purchaser, five thousand dollars has been wastefully spent and must be cared for by interest charges as long as the factory exists.

Similar situations are encountered by every boiler and engine manufacturer. It is confessedly difficult for, say, an engine builder to refuse to accept orders for special machines, particularly when his shop is not running full time. Still, it is seldom that all the extra costs can be saddled onto the purchaser, and the engine builder finds too frequently that the job is not so attractive as it seemed.

The same argument may well be placed against the common practice of calling for bids on unusual cylinder sizes, which means extra engineering, pattern and machine work. What is needed is a standardization by builders of their products and a decrease in the number of sizes of boilers, engines and like machines. If, for example, unaflow engines were standardized in cylinder sizes such as to give with one hundred and fifty pounds pressure outputs in multiples of fifty horsepower in capacities under four hundred, and in multiples of one hundred horsepower in larger engines, a real reduction in engine costs would be obtained. It is ridiculous to insist upon an engine with a normal capacity of twenty-five horsepower above or below a builder's standard, for the efficiency of an engine at even three-quarters load is practically the same as at full load.

Engine costs will never be as low as if a limited number of sizes were standardized by all builders. No builder can adopt real production as long as each order is for a different size of machine.

The oil-engine builders have more or less standardized on a few cylinder sizes. Manufacturing costs have been lowered by this process, and it is a matter of record that the builders having the fewest cylinder sizes sell the greatest number at the lowest prices.

Power for New England

SEVERAL hundred delegates from all over New England were in Worcester, Mass., on Nov. 12 and 13 to attend the meetings of the first New England Conference, for the discussion of the economic growth of that region.

One session was devoted to the consideration of power. Much was said of the advantages of the development of large power pools—systems of interconnected generating stations, hydraulic and steam, each located favorably from the viewpoint of low cost generation.

All this is good, but what of the industrial power user who requires heat as well, either for building heating or for process work? In a given case it may well be cheaper to buy power and to operate a boiler plant solely for heating, but if the balance between power and heating demands is favorable, as it often is, both can be generated in an independent plant at a lower cost, in many cases much lower.

It is unfortunate that the New England Conference session failed even to mention this important aspect of industrial power development.

Owing to the distance from the coal fields coal will always cost more in New England than in many other parts of the country, and high thermal economy must be correspondingly more significant. The generation of power with substantial recovery of exhaust heat affords possibilities that may not safely be overlooked. Uneconomic development based on the neglect of important considerations is as unsound for the central-station industry as for the independent power plant.

Why Cling to Antiquity?

IT IS not so long ago that the average engine room was a pretty dirty and grim place compared with the modern well-operated plant. Hard-surfaced concrete on tile floors has replaced the old oil-soaked types. The dark gloomy walls of the past have given way to those of light color, and good lighting has added much to making the engine room a desirable place in which to work. With this change in the design of the plant has come an improved housekeeping in its operation.

Although in general the idea that the color of the engine room should be in keeping with the color of the coal burned under the boilers has been dispelled, it has not been so generally recognized that the boiler plant can be made a place equally pleasing. There has been sufficient progress made, however, to show that even a white boiler room, in which coal is burned, is by no means a pipe dream. Such rooms are in operation and are kept white without undue effort.

In his home the average operating engineer is becoming accustomed to good lighting and pleasant surroundings. If he goes down into the boiler room of the power house where he is employed and finds it poorly lighted and gloomy, if there is a lack of interest in his work, it is about what might be expected. Some remarkable results have been accomplished in plants that were in general run-down and where the operating force lacked interest, by making them places where men like to work. When this was done, everyone took on a new attitude toward his work and the plants became objects of pride.

The boiler room is the part of the power station in which the over-all efficiency of the plant is established. No part of the plant requires such careful attention as the boilers to maintain their efficiency high. This being the case, every effort should be made to give to this part of the plant an atmosphere that will inspire and not depress. At one time it was generally believed that when coal was burned on the fire, the smoke should be the same color as the coal, but today black smoke from a chimney is looked upon as a relic of the past. And it is equally true that a dimly lighted, dingy boiler room is a hangover from an inefficient past.

Obsolescence May Be a Negligible Quantity

OBSOLESCENCE has been defined as the condition or process of growing into disuse. This does not necessarily mean that the object has become worn out, although economic laws may preclude its use. In the early history of an industry developments may be so rapid as to make a process or equipment obsolete before or soon after it is put into use. Such condition does not necessarily, however, take place in the early development of an industry, as is demonstrated in the central-station field.

For the first twenty-five years of growth in this industry the steam engine was the recognized type of prime mover. Then came the steam turbine, and since that time the rate at which power-plant equipment became obsolete in large condensing stations has been high. This has not been due to the equipment wearing out any faster than it ever did, but because of the economies obtainable with large steam turbines. These, combined with the economies obtained from other improvements in station design, have made it possible to scrap machinery that, in some cases, was in better condition than when installed, and replace it by more modern equipment. In doing so the saving in the cost of power generation was sufficient to pay the cost of the change in a few years, besides offering other advantages.

In non-condensing industrial plants the rate at which the equipment becomes obsolete may be very slow if the plant is properly designed and intelligently operated. In one case in mind the plant has been in operation for over twenty years, and the engines are today more serviceable than when they were installed. When occasion arose recently to increase the size of the plant, an engine of a type similar to the older units was installed. As far as it is humanly possible to foresee, there is nothing in the nature of the business served by this plant that would change the load character and make it uneconomical to operate the plant. Neither is there any possibility in sight of a prime mover being developed that will make it economical to replace these engines.

Applying the previous definition of obsolescence to an industrial plant of this kind, it would appear that its rate of becoming obsolete is practically a negligible quantity. Therefore, when obsolescence charges are to be made against power-plant equipment, the type of plant must be carefully considered, as under one set of conditions it may be economical to replace the apparatus in ten years or less, where in others the character of the load served may be such as to make it improbable that the machinery will become obsolete.

Team Work Between Pure and Applied Science

WHY either scientists or engineers ever failed in recognition of each other's merits is hard to understand. As a matter of fact the really big men on both sides of the fence always did entertain a lively respect and even affection for their silent partners in the business of enriching human life through a knowledge of natural laws. Lesser men—scientists too absorbed in their specialties to consider the broad implications of scientific advance, and engineers too busy putting up the superstructure to appreciate the work of the foundation builders—have at times displayed a petty spirit regarding each other's achievements. Scientists have been known to turn up their noses at the "hammer-and-saw artists." Engineers have frequently smiled at the "impractical" investigations of the scientific research worker.

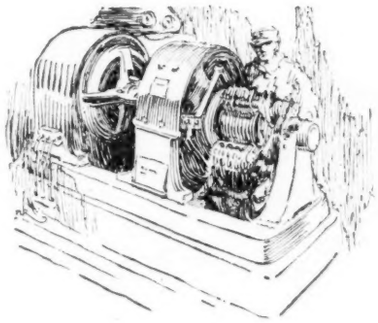
The day of this sort of thing is about done. Engineering achievements are too great to be ignored, while everybody knows that scientific investigations without promise of practical usefulness have repeatedly revolutionized the life and habits of mankind, particularly in the fields of physics, chemistry and biology.

One of the most hopeful signs of this age is the increasing desire of engineers and scientists to work together and understand each other. Fraternal feeling between these groups is promoted by such organizations as the four engineering societies and the American Association for the Advancement of Science. The last-named organization is strategically placed to advance this comradeship.

Its present spirit in the matter is exemplified by a resolution passed at a meeting of the Executive Committee on October 25. At the suggestion of Dr. Michael Pupin, a great scientist and an equally great engineer, Dr. J. McK. Cattell (editor of *Science*) and Ira N. Hollis (past-president of the A. S. M. E.) were appointed to promote fuller co-operation with the engineering societies. For the good of all, the engineers should welcome such advances with open arms.

Philadelphia's football, the Sesqui-Centennial, which recently was considerably deflated, has been blown up once more and the captain, Mayor Kendrick, has signaled for a new tackle.

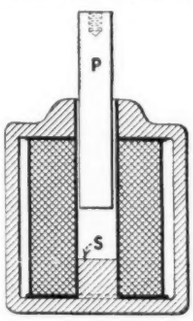
Practical Ideas from Practical Men



WITH a view to stimulating engineers into the habit of recording for the benefit of brother engineers, unusual occurrences, how these were met and other practical expedients adopted in the operation of their plants, Power has decided to award two cash prizes each month during 1925. One of $25 for the best and another of $15 for the second best practical letter on plant operation or practical kinks received during the month. This is in addition to payment for the contribution at space rates. The winners for October will be announced next month.

How a Penny Was Used to Repair a Magnet Brake Trouble

If the plunger *P* in an electromagnet is allowed to make iron-to-iron contact with the stop or plug *S* in the figure, the plunger is likely to stick in the closed position when the coil is disconnected from the source of power. To prevent this trouble occurring, a thin brass plate may be put on the end of the plunger so that an air gap will be maintained between the movable and stationary cores.



Section through electromagnet

In one case in mind a motor equipped with a magnet brake on an important drive, gave trouble due to the brake sticking at a time when it was essential that service be maintained. The plunger was quickly removed and a penny dropped into the plunger hole of the coil. The plunger was again put back into place and the equipment started without any further trouble.

Waterbury, Conn. C. R. UNDERHILL.

Making Belts Endless

The weakest point of a belt is at the joint, which is also the seat of many belt troubles. There are many methods of fastening belts at the joint, but the most satisfactory is to make the belt endless; that is, to lap the ends, and make a continuous belt.

In making a belt endless, the tools required are such as are in the possession of any carpenter, with the addition of a few extras, such as clamps, scraper, belt hoe and belt shave, also a sharp knife such as is used by a leather worker.

Having decided on the length of lap, which is governed by the width of the belt, and which in the case of single-ply belts is equal to the width, the belt is either removed to the bench or clamped firmly down on the pulley, then the lap to be cut off is carefully laid out, taking care that the heel and the edge of the lap are at right angles to the side of the belt. A bevel cut is then made with a spoke shave and scraped down with a scraper, making certain that no humps are left, the other side to be joined being dealt with in a similar manner.

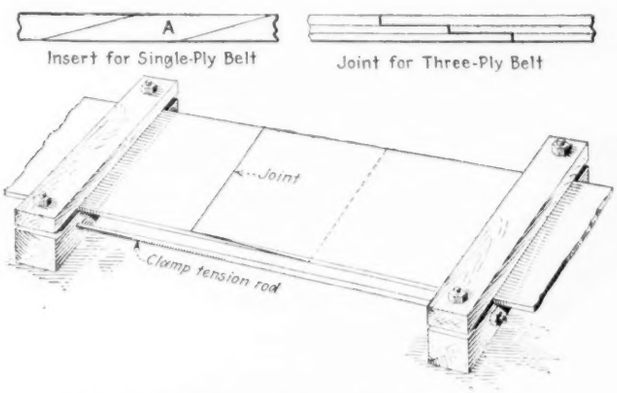
If the lap is to be made across an old splice, care must be taken that all traces of glue are removed by scraping until a leather-to-leather surface is obtained.

Both surfaces being thus prepared, the glue is thinly spread over each and well worked into the leather, the ends brought together and firmly held in place by means of boards held with bench clamps, and in the case of ordinary belt glue, or cement, left to harden for three hours or more before placing the belt on the pulleys.

If the belt is already joined in this way and is to be merely shortened, the lap should be opened up with a blunt chisel or screwdriver and, when a section is started, finished by hammering with the peen of a machinist's hammer. When the lap has been opened up, it is thoroughly cleaned and the surface well roughened up ready for the cement or glue.

The amount that is to be cut out of the belt having been determined, taking care that enough is left to make a splice, the belt is lapped and glued as previously outlined.

Where a joint is to be replaced by making a belt continuous, if there is sufficient material in the belt to make laps, the foregoing procedure applies, but if it is too tight, then it becomes necessary to make an



Types of joints used in making belts endless

insert as at *A* in the illustration. This is done by preparing the ends of the belt and the piece to be inserted as before described and clamping the well-glued section in place, taking care that it lines up with the rest of the belt. In the case of a two or more ply belt it is necessary to stagger the splices so that there is a section of belt between the break in the piece and the corresponding break in the next ply, also the joints are not beveled in this case but are carefully cleaned, scraped and glued together and securely clamped. There

are two kinds of glue in regular use—belting cement, and waterproof belting cement. The former is heated to near the boiling point in a water-jacketed pot and applied in a hot liquid state, diluted before heating with sufficient water to make a thin glue. Waterproof cement is a compound usually consisting of a celluloid base mixed with a volatile solvent, and is applied cold, taking care that all air is excluded from the container as soon as the required amount has been used. Three coats are applied, each one being allowed to dry before the next is applied. Then the ends are brought together and clamped before the third coat has had time to dry.

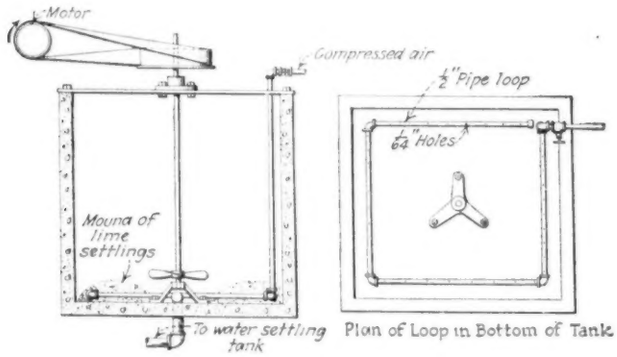
In the case of an endless belt that will not stay on the pulleys, resource should not be made to a belt dressing, but rather to checking up as to the trueness of the pulley, if the joint has been made square, whether the face is greasy, etc. The only lubricant needed is a dressing of neats-foot oil on the surface away from the pulley surface. This is to take care of the friction evolved from the constant motion of the molecules of leather working against one another.

Hollywood, Calif. MAURICE C. COCKSHOTT.

An Air Agitator for Lime Tank

In connection with our power house we have a water-filtering plant, part of which consists of two 4x4x4-ft. concrete tanks for making up the treatment solutions. Each tank is equipped with a propeller wheel agitator located about 9 in. above the bottom of the tank over a crowfoot bearing.

We found that there was a certain part of the solution in the lime tank below the propeller that had very little movement. In this portion of the tank heavy particles of lime would accumulate and settle, so that after a few weeks there would be a circular mound of lime settlings, which usually had to be shoveled out.



Perforated air pipe in bottom of tank prevents lime accumulating below agitator

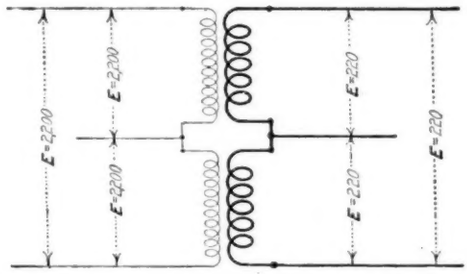
We discovered that by extending an air nozzle down into the lime mound it would be stirred up and dissolved.

As a result of this experience I made a permanent air agitator by putting a ½-in. pipe loop around the bottom of the tank the upper side of the pipe being drilled with a row of small holes about 4 in. apart. The loop was connected by a riser to the shop-service air line. By using this air agitator a few hours each day, the bottom of the tank was kept free of accumulation of lime settlings. L. M. JOHNSON.

Sewickley, Pa.

A Large Motor Not Always a Desirable Load

On the lines of a small municipally owned plant, a motor, large in comparison with the power-plant capacity, was installed, and I was called to find out why this motor started so hard and created such a disturbance with the voltage of the system when thrown on or off. The power plant consisted of two units, each a 70-hp. oil-engine direct-connected to a 75-kw. 2,300-volt three-



Two transformers connected open-delta

phase alternator with belted exciter, an engine capacity entirely too small for the generator rating at an altitude of over 5,000 ft. These units were arranged for parallel operation. Normally, one engine alone easily carried the load at any time until the large motor was installed, when it was found necessary to have both units in operation.

This motor, which was of the slip-ring type, was rated at 30 hp. 440 volts three-phase, was geared to a large locomotive turntable and was used from ten to twenty-five times a day at any time the demands of railroad traffic required. Under the very best conditions the motor could be expected to cause serious voltage fluctuations on a system of such small plant capacity.

An alarm-bell circuit had been installed between the turntable and the power plant to notify the operator when the turntable was to be used. Then the operator would attempt to keep the voltage up by hand as the motor started up, and in this way managed to get the motor and turntable in motion. When the motor was cut off, the voltmeter needle at the plant usually threw over and off the scale before the operator could adjust the voltage. To make matters worse, the engines governed badly, their speed dropping nearly 10 per cent when the motor was in use.

Investigating the trouble, it was found that while the motor was starting, the wattmeters on the power-plant switchboard indicated an actual load of only about 24 kw., but the current was excessive and remained so after the motor appeared to come up to speed. The motor was fed through two transformers connected in open-delta, as shown in the figure, which were built for 2,200 volts primary and 220 volts secondary, hence were supplying the motor at less than half voltage, under the condition they were operating. Calling this to the attention of the manager of the plant, who had made the installation, he argued that the two transformer secondaries, being connected in series and each being for 220 volts, would supply the motor with 440-volt current. This, of course, is wrong, since the voltage is the same on all three phases as in the figure.

Installing correct transformers so much improved

the motor operation that it was possible to start it with but one generating unit in operation, but the system voltage conditions were improved but little. However, with both units in operation, conditions were some better but far from good.

Worse, if possible, than the operating conditions in connection with this installation, is its economic aspect. The plant, as stated, is municipally owned, and the management, evidently under the mistaken impression that a big motor should be a large revenue producer, disregarded the conditions under which the motor operates; that is, some ten to twenty times a day and not over three minutes at a time, and these are as likely to come at times of peak load as any other. At any rate a long-time contract was made to furnish current for this motor at a rate of 5c. per kw.-hr. with no service charge, and the records show that during the past year the monthly revenue from the installation has never exceeded $25. Little more than enough to pay for the lubricating oil used in the extra unit that is kept in operation most of the time for no other purpose than to handle this load, and nowhere near enough to compensate for the nuisance it is to the service given the other customers. A motor large in proportion to the generator supplying the power, should be avoided wherever possible.

J. H. BENDER.

Clayton, N. M.

Tools To Overcome Inaccessibility of Engine Parts

Oil engines of the trunk-piston type are often built in units of comparatively high power. The cylinder heads and pistons of such engines are quite heavy, and since these are generally removed to adjust the top-end bearings, operators often complain that the work involved in making such adjustments is excessive in comparison to similar work on engines of the crosshead type.

With that in mind they may lose sight of the advantages of this type of engine over the latter. The elimination of crossheads, with slippers and guides and sometimes an extra set of bearings, is an advantage both in cost of construction and number of working parts to be taken care of. Any number of points of superiority of the one type over the other might be presented in weighing their relative merits.

Without upholding either one side or the other of such an argument, it is my intention to demonstrate that the adjustment of the top-end bearings of some trunk-piston types of engines is not such a great problem as it may seem at first glance. The method herewith described has been successfully employed in engines of from 500 to 750 hp. They were slow-speed engines with cylinder bores ranging from 16 to 22 in. in diameter. In smaller engines piston removal would not be a great task provided the top-end bearings were made adjustable, but since they are often solid bushings pressed into the top end of the rod, piston removal becomes necessary in any event.

Since the engine builders had not provided suitable tools, we had to have them made. A heavy crowfoot wrench *A* with a series of holes at different angles in the lower end; a bar *C* to fit the holes; a lever *B* with a ring welded on one end to fit the base of the wrench and hold it firm, and the end cut out to fit around the connecting rod, which prevented it from swinging while pulling on the bar; a block *F* to fit in the crankcase door and use as a fulcrum for the pry or lever *B*, constituted the set of tools used for slacking back the nuts and setting them up again. They were used in the manner shown in Fig. 1.

Two other tools for raising the piston were made, as shown in Fig. 2. The lever *E* had a fulcrum attached to the under side and a small hole drilled through it just beyond the fulcrum. The bar *D* was pointed at the lower end to fit in the hole in the bar, which prevented it from slipping, while the upper end was forked in such a way as to fit over the skirt of the piston and prevent it from slipping. When in position the fulcrum attached to the lever *E* would rest on the crank web.

After slacking the nuts with the arrangement shown in Fig. 1, the piston was lifted with the bar and lever shown in Fig. 2, just enough to permit the removal of the shims between the two halves of the top-end box.

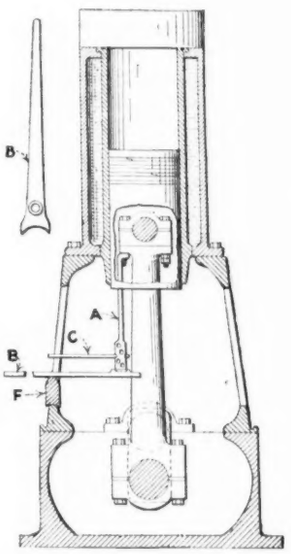


Fig. 1—Tool for slacking nuts on top-end bearing

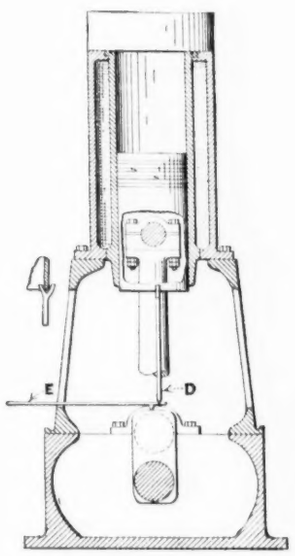


Fig. 2—Tools for raising piston to remove shims

A small block of lead, slightly thicker than the shims was inserted between the two halves of the box and the nuts pulled up until the bearing was just tight enough to show no slack when the piston was lifted with the lever *E* but free enough to swing the connecting rod freely from side to side. The nuts were again slacked back and the pieces of lead removed and gaged with micrometers. An equivalent thickness of shims was reinserted and the nuts pulled up again; thus an adjustment was made eliminating all guesswork as to how much clearance existed.

While the tools described proved to be very serviceable, the engine builders never could see any advantage in their use, maintaining that pistons should be removed to make the adjustment despite the fact that we often found it necessary to "key up" when piston removal would not be necessary for any other reason, such as cleaning rings or making an inspection.

Despite this difference of opinion between myself and the engine builders, the tools were used for three years to my knowledge and I have never heard of their abandonment by any successor.

A. B. NEWELL.

Woodbury, N. J.

Comments from Readers

Checking Watt-Hour Meters with a Rotating Standard

I wish to criticize the article by Willard F. Walsh in the Sept. 15 issue, on "Checking Watt-Hour Meters with a Rotating Standard." In reading it I was impressed with the fact that it left considerable chance for doubts to arise in the mind of the average operating man. I realize that a complete treatise on the subject of meter testing cannot be attempted in your periodical, but the operating man who reads the article referred to may find himself in a peculiar position, if he attempts to test watt-hour meters from the information given.

For instance, the author makes the following statement on page 401: "Therefore the upper element is one per cent slow. If the lower element is also about one per cent slow, etc." What if the lower element is more or less than one per cent slow? How is the operating man to adjust the meter?

I feel that it is poor policy to leave this question of equality of elements in doubt. The present condition of low power factor in industrial plants requires that the elements of a watt-hour meter be very closely balanced in order to obtain proper metering, and serious errors can be experienced if this condition of balance is not met.

I believe it would be advisable, if the subject of balancing of the elements could not be treated in this article, at least to refer to the manufacturer's instruction books which accompany the meters, where the means for doing this are outlined.

Also on page 402 this statement appears: "These light-load adjustments affect only the element that is being adjusted." This statement is not strictly true. I will admit that the particular light-load adjustment of either element affects the electromagnetic circuit of that element only. However, the percentage registration of the whole meter is changed when the light-load adjustment of either element is changed.

Utica, N. Y. W. D. WILKINSON, Elec. Eng.,
Utica Gas & Electric Co.

Engine with Short Cutoff Reduces Power Costs

While reading over the catalog of a manufacturer of Corliss engines containing tables and charts showing the power available from a given size of cylinder at various pressures and cutoffs, the writer found one set of figures was of more than usual interest. This gave the power that could be generated by a noncondensing 18x30-in. engine at one-third cutoff and 100 r.p.m., using steam at 130 lb. pressure, as 234 hp. and the power generated by an 18x48-in. engine at one-fifth cutoff as 265 hp. at the same r.p.m. and steam pressure.

Now it struck me that with the larger engine cutting off steam at one-fifth stroke, or 9.6 in. from the beginning, and the smaller unit at one-third cutoff taking steam for 10 in. of the stroke, the steam consumption was actually less with the larger unit and the power output considerably greater. In fact, the larger unit developed 13.25 per cent more power with 4 per cent less steam flow, the diameter and cylinder clearance being the same in each case.

I started to make a comparison of the relative steam rates. Letting X be the steam rate of the small engine, the steam flow at one-third cutoff is $234X$ and at one-fifth cutoff the steam flow in the large unit is 96 per cent of $234X$, making the steam rate of this unit $\frac{224.6X}{265}$, or 85 per cent of the rate of the smaller unit. This means a reduction of 15 per cent in steam consumption by using an 18x48-in. engine at one-fifth cutoff in place of an 18x30-in. engine with one-third cutoff. Many engines are operating with cutoffs as late as one-third stroke, and the question naturally arises as to whether it would pay to replace these engines with larger ones, thus bringing the cutoff back to one-fifth, which appears to be the economical point for most noncondensing engines at 130 lb. initial pressure. The operating costs of two engines as described herein can safely be assumed to be as follows: Water rate of large engines at one-fifth cutoff will be about 21.5 lb. per hp.-hr., and of the smaller unit $\frac{21.5}{0.85}$, or 25.3 lb. per hp.-hr. With a load of 234 hp. and an evaporation of 8 lb. the fuel cost of running the small engine would be 740 lb. of coal per hour, or 18.5 tons in a 50-hour week. At $7 a ton the weekly fuel cost would be $129.50 and the annual cost comes to $6,534. With a water rate 15 per cent less an engine large enough to carry the load at one-fifth cutoff would save $980 a year. Obviously, this saving is not large enough to warrant the purchase of a new engine, which at $40 per hp. would cost $9,360 and the fixed charges at the low figure of 11 per cent would offset the fuel saving.

But suppose this engine was operating in an industry that had a steady 24-hour load for 300 days a year. The proposition then assumes different proportions. The saving per hour is the same in each case, but the second plant operates 7,200 hours a year, while the first operated only 2,522 hours a year. So the annual saving in the second case will be $2,797. This amounts to over 30 per cent of the required investment, but it would in many cases be impossible to induce the management to buy a new engine, even with a saving as large as this.

Another plan could be followed, which would greatly reduce the first cost and effect a substantial saving. We have seen that the 18x48-in. engine developed 265 hp. at one-fifth cutoff, so if the 18x30-in. engine is operated at reduced load, to secure the same cutoff the power output will be 37.5 per cent less and all other running conditions are the same in both engines. Therefore it will develop 165 hp. at the earlier cutoff and the balance of 69 hp. must be supplied in some manner. Another engine of 69 hp. could be installed, and assuming the cutoff, pressure and piston speed

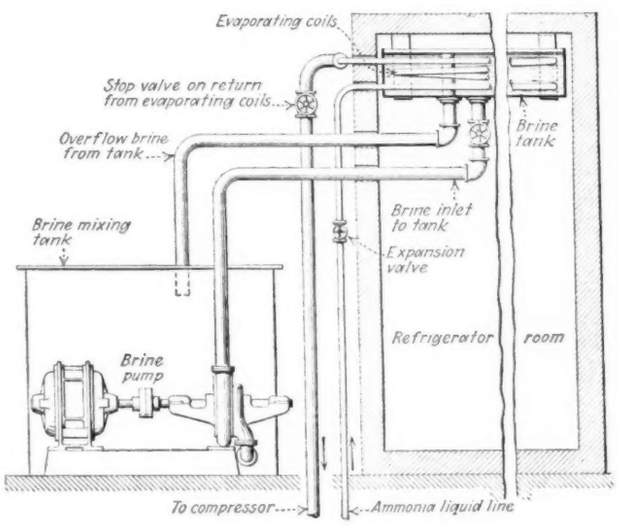
to be the same as the other engine, the cylinder area would be 41.8 per cent of the 18-in. cylinder. This calls for a cylinder diameter of 11.63 in., and the nearest commercial size would be 12 in. If purchased new, the cost would not exceed $2,832, consequently the entire cost is returned in one year by the fuel saving. It would also be possible to purchase a second-hand unit of 69 hp. which would not cost over $1,400, and the saving would be correspondingly greater

Springfield, Mass. A. F. SHEEHAN.

Brine Tank for Cooling Coils

In *Power* for Oct. 6 R. I. Tullis submits a sketch of a plan to prevent the formation of frost on the expansion piping of a cooling room and invites criticism. In my opinion the plan proposed is not the best solution and is open to condemnation on several counts.

Let us consider the cooling surface presented to the atmosphere of the cooler. As he proposes to insulate



Suggested cooling-coil arrangement

the bottom and sides of the tank in order to prevent formation of frost upon them, there remains only the upper surface of the brine for the absorption of heat.

To illustrate this, take a room 11x16 ft., having suspended from its ceiling a three-layer coil of 2-in. expansion piping, the coils being 15 ft. long, bent on 8-in. centers. Such a coil will contain approximately 500 lin.ft. of pipe giving an external area of 312.5 sq.ft.

A cover tank for this coil would have to be $10\frac{1}{2}$x$15\frac{1}{2}$ ft. and its surface would total 162 sq.ft. Were the pipe coil only one layer deep, the ratio of exposed surfaces would be altered, becoming 162 to 104. With the arrangement proposed, two heat exchanges must occur and a temperature difference of from 6 to 10 deg. will exist between the brine and the ammonia in the coils. This means the maintaining of a lower back pressure at the compressor to produce the same cooling effect, and the compressor capacity would be decreased due to the low back pressure.

The chief objection, and really the only one that need be taken into consideration, is the fact that no cooling action can take place except that due to the surface action.

Cooling by conduction from the surface of the liquid downward to the submerged coils will be virtually nil. Mr. Tullis may satisfy himself of the truth of this statement by a simple experiment: Procure a shallow pan, fill it with water and place it upon a cake of ice, and apply the flame from a gasoline blow torch to the surface of the water. Note carefully what happens to the ice. OSCAR CRITCHLOW.

Bellingham, Wash.

The Centrifugal Pump and Its Applications

I have read with much interest the various articles by Russell K. Annis which have appeared in *Power* from time to time, dealing with the centrifugal pump and its applications.

His last two contributions appearing in the July 14 and Sept. 22 issues contain, in my opinion, some misleading and even incorrect statements, to which I wish to call attention.

In the July 14 issue Mr. Annis sets forth a method of selecting a pump so adapted to the pipe line that the best results will be obtained. This method, it seems to me, is a very unusual piece of reasoning and does not have any real relation to the problem he attempts to solve.

The problem is not, as he states, to fit the pump to the pipe line, but rather the reverse, namely, having a given pump of known characteristics to fit the pipe line to the pump. What is really desired is a size of pipe that will give the greatest financial efficiency; that is, the most economical size of pipe, everything considered. The method of determining the economical size of pipe for a given installation is well known to most hydraulic engineers and involves consideration of such questions as the cost of power, cost of pipe in place, taxes, depreciation, repairs, etc. The curve in the first article referred to shows very clearly that the pipe size is too small. Mr. Annis therefore recommends either to reduce the speed, the impeller diameter, or the size of the pump. None of these would be correct, for they all reduce the capacity, which is invariably fixed by other considerations. What is obviously needed is a larger size of pipe. Were it not for the cost of the pipe, a size might be selected that would give the pipe-line efficiency a value close to 100 per cent. The real problem is therefore a balance between the saving in power due to the larger pipe and the increase in cost of using it over the smaller size. There is a great deal more to it than the article would indicate.

In the issue of Sept. 22 Mr. Annis attempts to prove a side-suction pump more efficient for small capacities than double-suction type.

It is well known that the double-suction pump is the more efficient type, and I therefore have gone over his article with more than usual interest.

Mr. Annis has here made the error of comparing, not a side-suction pump and a double-suction pump, but rather two pumps, one designed for half the capacity of the other. He has made a second error in assuming that the maximum efficiencies of the two are identical. He would surely not say that a pump designed for 500 gal. per min. would have the same efficiency as one for 1,000 gal. per min., and yet that is what his curve in Fig. 3 indicates.

A third error lies in the assumption that the efficiency of either half of a double-suction pump is the same as that of the whole pump. This is obviously impossible, as the following reasoning will show:

The efficiency of the pump is the output divided by the output plus the losses. The losses consist of the following: Bearing friction, stuffing-box friction, disk friction of the impeller and the internal leakage. Now these losses are about the same for either type of pump, hence if in the case of a side-suction pump we have about the same losses as for a double-suction type and at the same time have only half the output, it is hard to see how the efficiency could be the same. The losses in the case of the side-suction pump are a greater percentage of the output than in the double-suction type and hence the efficiency is lower, as would be expected. This has been amply confirmed in practice.

It is true that a pump designed for 500 gal. per min. will show better efficiency at that capacity than one designed for 1,000 gal. per min. and operated at half capacity, and that is all that the curves in Fig. 3 show. The foregoing is true for either the side-suction or double-suction type and could not well be used to prove the superiority of either. To prove his point Mr. Annis should compare two pumps, each designed for the same conditions, one being a side-suction and the other a double-suction pump. This will undoubtedly show the double-suction to be the more efficient.

Ann Arbor, Mich. ALLEN F. SHERZER.

Who Should Be the Boss?

Answering R. S. Buchman's question in the Sept. 8 issue, "Who Should Be the Boss," I would say that conditions in the mill as he describes them should certainly be changed without delay. The owner of the mill should find out at once what excuse the master mechanic and firemen have for being drunk while on duty. This condition should not be tolerated.

If he employs firemen who allow the water in the boiler to get so low that they must be ordered to start the injector or pump, he had better close down his power plant and buy power and thereby save the lives of his employees as well as the cost of extensive repairs due to "lack of orders."

Personally, I think the right thing for the owner of the mill to do is to secure a master mechanic who will acknowledge the engineer as having full charge of the engine and boiler room, including all minor repairs and adjustments.

The master mechanic can be in the power plant but a very small part of his time except when extensive repairs or installations are being made, so that it is quite essential that he have a competent engineer whose word is law in the power plant.

New Kensington, Pa. OLIVER R. ANDERSON.

The letter by R. S. Buchman interested me because for many years I was chief engineer and master mechanic in different power plants in government hospitals. At each of these institutions there are carpenter shop, laundry, steam and electric plants, water works, sewage-disposal works, paint shop, etc. All power equipment, including belts, shafting, wood-working and laundry machines, was in my charge. The superintendent at each of the hospitals gave orders to the painter, carpenter, etc., if he wanted any work done in these lines, but I, as chief engineer, being responsible for all mechanical equipment and operation in general, was absolute boss over all such material. The superintendent could instruct me to deliver more heat, light, hot water, etc., wherever he wanted it, but he had not the authority to instruct one of the boiler or engine room staff to do any work. If he wanted any alterations or additions to any pipework or mechanical equipment or even the location of a heating radiator changed, he consulted me first.

There were government inspectors who made inspections of the plants frequently, but during the many years I was in the service I do not remember a single instance where any new equipment was installed or alterations made in the plant without first talking the matter over with me. I have been out of the government service for several years, but so far as I know the same plan is still in force. The plan appears to work out well, for there is seldom any trouble in these plants and efficient and economical service is delivered.

Toronto, Canada. J. E. NOBLE.

More Information Needed

The editorial, "Information for the Operator," in *Power* of Oct. 20, was very much to the point, for frequently there are occasions when an exact knowledge of the construction of a piece of machinery would enable the engineer to decide from its behavior the probable cause of any trouble that arises. As it is, he is left completely in doubt until the machine can be taken out of service and dismantled for inspection.

A very useful sort of information, not usually given, is how parts are fastened; sometimes it is necessary to break them to find out. For instance, one is often in doubt as to how the piston is fastened on the rod. Is it screwed on and riveted over, forced on and peened into a countersink, or is some original scheme thought up by the designer? The same applies to gears and arms attached to shafts and rods.

Getting this information into shape might lead the designer to wonder how the operator was going to get it apart and avoid constructions in which, as on the governor-valve mechanism of a turbine-driven boiler-feed pump we have, it is easy enough to drive the rocker shaft into the fork operating the governor-valve cage, but there is no way of driving it out without drilling a hole in the housing casting.

A more general use of taper pins instead of straight pins for holding small levers to shaft would be very convenient, as they can be readily procured to standard dimensions and a slight touch with the reamer will make them fit. It is difficult both to find cold-rolled stock accurate enough to make the tight fit required and to obtain stock sufficiently oversize for use in a hole after the old pin has been driven out and in several times. With straight pins it is often hard to tell from which end they were driven and consequently to remove them without damaging them so much as to require renewal.

The use of standard keys—that is, sizes of square cold-rolled steel readily obtainable—is increasing and rightly so. In making a replacement key it is much quicker and easier to touch up a piece of cold-rolled steel than to work down a larger chunk to some uneven size, particularly with the average plant facilities.

New Haven, Conn. H. D. FISHER.

Questions and Answers

Conducted by

Franklin Van Winkle

Use of Oversized Reducing Valve

What are the disadvantages of using a larger steam-pressure reducing valve than necessary for supplying the maximum rate of steam flow required? C. M.

In most forms of pressure-reducing valves the lift, or valve movement, is small in comparison with the circumferential measurement of the valve seat, and the larger the valve the less the lift for a given rate of flow. Hence, when the valve is used below its capacity, it is not capable of effecting close differentiation of pressures and there will be greater wiredrawing of the steam and erosion of the valve face and its seat than if the valve were smaller.

Mixing Tank for Tepid-Water Supply

To obtain a supply of tepid water used in a public institution, it is proposed to draw the warm water from a mixing tank, provided near its bottom with hot and cold water connections that are supplied through thermo-control valves for maintaining the desired temperature of water in the mixing tank. Will circulation be sufficient to prevent water in the mixing tank from becoming cooled? H. C. F.

At times when no water is being drawn from the mixing tank, some cooling would be taking place, as this tank, along with the supply line to the fixtures would be a dead end in the system. This condition would be improved if the mixing tank were provided with a good non-conducting covering, but that would not prevent lowering of the mixing-tank temperature nearly to the temperature of surrounding air during long intervals between drafts of water. The cooling could be compensated by a thermo-controlled steam coil placed in the mixing tank.

Pressure per Square Inch per Foot Head of Water

In estimating the height or head of water required for the exertion of one pound pressure per square inch, some authorities assume that each foot of head causes a pressure of 0.433 lb. per sq.in., while others use the constant 0.434. Which is correct, or why this difference? T. W. B.

The pressure per square inch for each foot of head depends on the density or weight per cubic foot, which varies with the analysis, temperature and pressure of the water. The temperature at which pure distilled water has greatest density when under atmospheric pressure is 39.1 deg. F., and under these conditions the density is about 62.425 lb. per cu.ft. and therefore the pressure per square inch per foot of height, which would be the same as the weight of a column 1x1x12 in., or 12 cu.in., would be $62.425 \div 1{,}728 \times 12 = 0.4335$ lb. per sq.in. At the ordinary temperature of 62 deg. F. and at atmospheric pressure, the weight of rain water is about 62.335 lb. per cu.ft., and the pressure per square inch per foot of head would be about $62.335 \div 1{,}728 \times 12 = 0.43302$ lb. The value 0.433 is the one most generally employed by engineers, and as water is so nearly incompressible no allowance is made for increase of the density due to the head.

Formula for Computing Pump Capacity

What is a short formula for computing the capacity of a double-acting piston or plunger pump? C. C. H.

Neglecting the reduction of displacement due to presence of a piston rod and slippage, the theoretical displacement of a pump having one double-acting piston or two single-acting plungers of the same diameter, is given by the formula,

Displacement in U. S. gal. per min. = area of water piston (or cross-sectional area of plungers) in sq.in. $\times$ piston or plunger speed, ft. per min. $\times$ 12 $\div$ 231; or if G = displacement of one double-acting water piston or two single-acting plungers, in U. S. gallons per minute; where d = diameter of piston or plungers in inches, P = piston speed, feet per minute,

$$G = 0.0408 d^2 P.$$

For a single acting pump, divide G by 2.

For a duplex double-acting pump, multiply G by 2.

For a triplex single-acting pump, multiply G by 1½.

For a triplex double-acting pump, multiply G by 3.

When the actual capacity is to be calculated, the reduction of displacement due to presence of piston rods and slippage is to be deducted from the theoretical displacement.

Static Condenser Applied to Alternating-Current System

On an alternating-current power system the load is about 550 kw. at 0.70 power factor. What would be the effect of adding a 150-kva. static condenser to this system? M. O. S.

The load on an alternating-current system may be considered as being made up of two components at right angles. One of these is the true power, or kilowatts, and the other the reactive part of the load, which in the case in question is lagging. These two components being at right angles, form the two legs of a right-angled triangle, the third side of which is the kva. load on the system, which is found by taking the square root of the sum of the squares of the two legs of the triangle, or of the kilowatt and reactive components of the kva. load.

The kva. load on the system equals the kilowatts divided by the power factor, equals $550 \div 0.70 = 786$. The lagging reactive component of the load equals the

square root of the difference of the squares of the kva. and kw. loads, equals $\sqrt{786^2 - 550^2} = 560$. The static condenser will reduce the lagging reactive component by an amount equal to the condenser's ratings. Then, with the condenser added to the system the reactive component becomes 560 — 150 = 410 kva., and the kilowatt load can be assumed to remain constant. Therefore the system load with the condenser added is $\sqrt{550^2 + 410^2} = 686$ kva., or a reduction of 786 — 686 = 100 kva. The power factor of the new load will equal 550 ÷ 686 = 0.80. As a result of putting the 150-kva. static condensers on the system, 100 kva. generator capacity has been made available, the power factor has been raised from 0.70 to 0.80, the losses in the system have been reduced an amount depending on where the condenser is installed and the voltage regulation has been improved due both to the reduction of the lagging current transmitted in the system and to the reduced effect of this current upon the generator field poles.

Starting Up Double Eccentric Engine

Why should a double-eccentric Corliss engine be started up by supporting the governor so release of the steam valve will occur inside of the range of cutoff, while for starting a single eccentric engine, disengagement of the steam valves need not take place until the speed is high enough for cutoff to be obtained by the governor? *A. D. V.*

With either a single- or double-eccentric valve gear disengagement of the steam valves cannot take place after the wristplate has swung farthest to one side of the center of its travel, that is, after the eccentric has reached the dead point of its travel. Thereafter the valve remains in control of the eccentric without disengagement and without becoming closed until enough rotation of the shaft has been accomplished for the eccentric to return the wristplate to the position it had when the valve began to open.

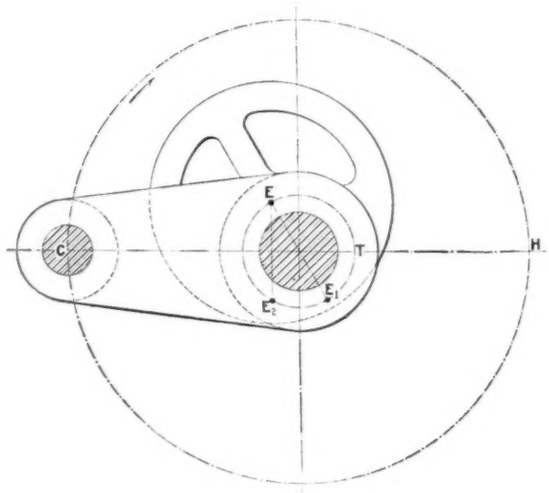
Proper action of the exhaust valves of either a single- or double-eccentric engine requires their movement to be obtained from an eccentric that is at least 90 deg. ahead of the crank, and to obtain prompt release and compression, this eccentric must be set ahead of the 90-deg. position. With the steam valves operated by the same or another eccentric thus set at 90 or more degrees ahead of the crank, disengagement of the valve for cutting off must occur before the crankshaft has been rotated 90 deg. from the crank dead center.

But in the double-eccentric engine, since the steam eccentric is independent of the exhaust, longer range of cutoff than 0 to ½ stroke may be obtained by setting the steam eccentric less than 90 deg. ahead of the crank and giving the steam valves negative lap so they will open in the beginning of the stroke. The eccentric then reaches the dead point in its travel for maximum length of cutoff as many degrees of rotation later than 90 deg. as the eccentric may have been set less than 90 deg. ahead of the crank.

In a single-eccentric engine the eccentric begins to open the valve with the eccentric at 90 deg. or more ahead of the crank and no more than 90 deg. of rotation of the crank from dead-center position can occur to bring the wristplate farthest to one side, and if disengagement of the valve has not taken place, no more than an additional 90 deg. rotation or completion of stroke of the piston is necessary for returning the wristplate to the position where the wristplate linkage returns the valve to the closed position.

But when the eccentric is set less than 90 deg. ahead of the crank and disengagement has not taken place, the valve is not returned to the closed position when the piston has reached the end of the stroke, because more than 180 deg. rotation is necessary to place the wristplate in the position it had when the valve began to open. Under the circumstances, if the valve was not disengaged at or before the latest point of cutoff, it follows that for at least a portion of the return stroke steam would blow through the open exhaust valve in the same end of the cylinder.

That the steam valve would not be closed until some time after the beginning of the return stroke may be understood from the figure. Suppose that at the beginning of the stroke the crank is at C and the eccentric at E and its greatest travel toward the right is to the point T. Then when the piston has completed a full stroke with the crank carried from C through 180 deg. to H, the eccentric turning through the same number of degrees is carried to the position E_1 and the additional rotation from E_1 to E_2 for closing the valve must be performed during the first part of the return stroke before the eccentric can arrive at the position E_2 for bringing the wristplate back to the same position it had when the valve began to open. Hence unless the valve was previously disengaged by the governor the steam admitted to the cylinder during this period of the return stroke would blow through the open exhaust valve in the same end of the cylinder.



Action of unreleased Corliss valve when eccentric has negative advance

Meanwhile the admission valve of the opposite end of the cylinder is open and the difference of steam pressures on opposite sides of the piston would be of some assistance in getting the engine under way. If blowing through is to be avoided, when the eccentric is placed for obtaining cutoff at later than one-half stroke, the engine must be started within the range of release for cutoff by the governor, and for that purpose the governor must be supported to a position where disengagement may take place from the beginning.

[Correspondents sending us inquiries should sign their communications with full names and addresses.]

A new slant on things observed in and out of the power plant

What Happens and Why?

Humidity

TO THE man in the street high humidity means high moisture. This idea is only partly in accordance with the facts. For any given temperature more moisture means more humidity, but the winter air may be more humid than that of a summer's day and still contain less moisture. Again, if the humid winter air is drawn into a building and heated by steam coils, the heated air contains as much moisture as before, yet its humidity is greatly reduced.

These apparent paradoxes present no difficulties to one who understands the true meaning of humidity.

The maximum weight of water that can exist as a vapor in a cubic foot of volume depends only on the temperature. It is merely the density of saturated steam as given in the steam tables. For example, 1 cu.ft. at 70 deg. can contain 0.00115 lb. of saturated vapor. The value is not affected in any way by the presence of air. Therefore, if a cubic foot of "air" at 70 deg. contains 0.00115 lb. of water vapor, it is "saturated" and can contain no more.

Humidity, or (to be more precise) "relative humidity," may be defined as the ratio of the actual weight of water vapor present to the maximum possible for the given temperature, this ratio being expressed as a percentage. "Saturated air" has a humidity of 100 per cent. If, for example, a sample of air at 70 deg. contains one-half of 0.00115 or 0.00057 lb. of moisture per cubic foot, its humidity is 50 per cent.

An easy and fairly accurate way to measure the humidity of still air is to observe the dew point. A pitcher of ice water, a polished silver or nickel-plated cup and a thermometer are all the apparatus needed.

Suppose the room temperature is 65 deg. Fill the bottom of the cup about one-third full of tap water. Then add ice water slowly, stirring with the thermometer. Note the temperature where a film of dew just starts to form on the cup. Continue stirring the water in the cup until the temperature rises just enough to dissipate the dew. The average of these two temperatures is a fair value for the "dew point."

Suppose this dew point is 42 deg. F. That shows that when the film of air next to the cup is cooled to 42 deg., it becomes saturated. The steam tables show that saturated vapor at 42 deg. weighs 0.00044 lb. per cu.ft. The same weight must have been present at 65 deg., where the capacity is 0.00098 lb. per cu.ft. Therefore the relative humidity is $100 \times 0.00044 \div 0.00098 = 45$ per cent.

The higher the humidity the less the evaporation from any damp object. In humid weather the family wash dries slowly, while a combination of high humidity and fairly high temperature makes people uncomfortable because perspiration, whose evaporation normally cools the body in hot weather, will not then evaporate readily.

During cold weather, on the other hand, discomfort and injury result from too low humidity indoors. Heating the outdoor air without adding moisture reduces the relative humidity to a point injurious to health.

Humidity can be measured by comparing the reading of an ordinary (dry-bulb) thermometer with that of a thermometer whose bulb is covered with a wet muslin wick (see Fig. 2). At 100 per cent humidity the two thermometers will read alike. The lower the humidity the farther will the wet-bulb temperature fall below that of the dry bulb. The table permits the direct determination of humidity from the readings of the two thermometers. For the temperatures shown in Fig. 2 the humidity is 48 per cent.

The simple equipment of Figs. 1 and 2 is the basis upon which has been built the more refined apparatus designed for scientific and commercial uses. The cup and pitcher of ice water have become the "dew point hygrometer," while the arrangement of Fig. 2 has been remodeled into the more accurate "Sling psychrometer."

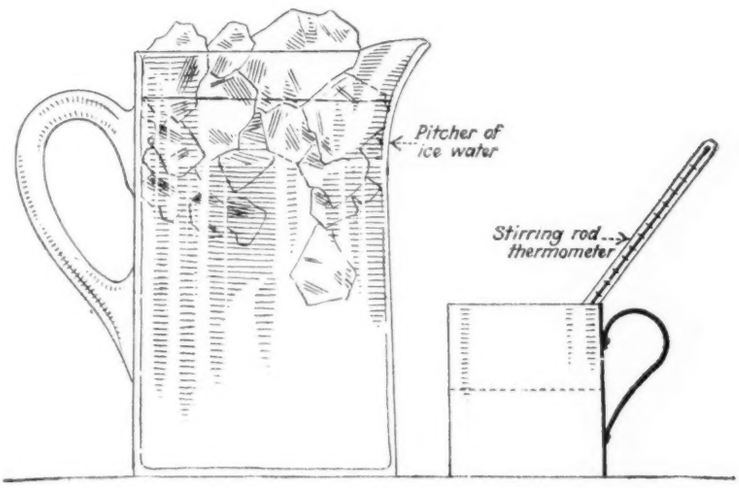


Fig. 1—Humidity can be figured from a simple dew-point determination

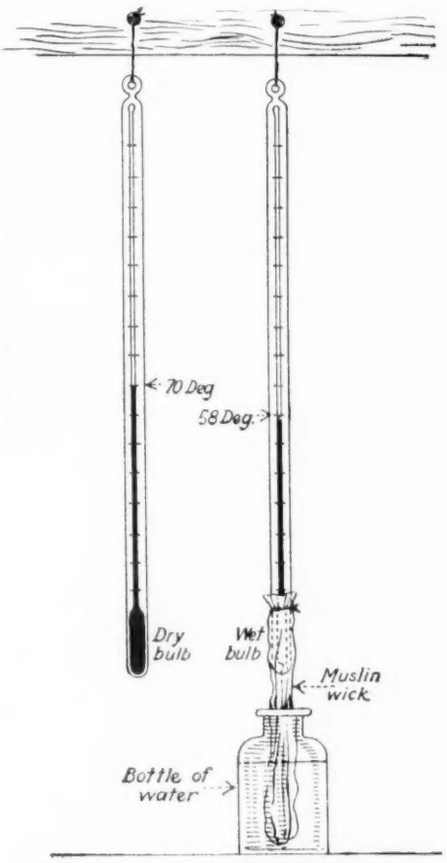


Fig. 2—Dry and wet-bulb thermometers

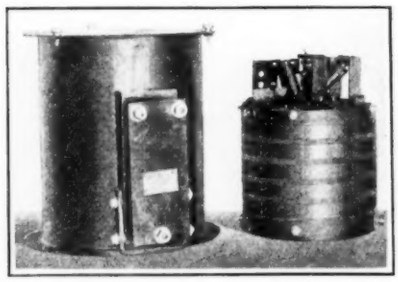
RELATIVE HUMIDITY FROM READINGS OF WET- AND DRY-BULB THERMOMETERS

Dry-Bulb Temperature	Difference Between Thermometers, Deg. F. 2	4	6	8	10	12	14	16	18	20
32	79	59	39	20	2	..	..	..	..	..
40	83	68	52	37	23	7	..	..	..	..
50	87	74	61	49	38	27	16	5	..	..
60	89	78	68	58	48	39	30	21	13	5
70	90	81	72	64	55	48	40	33	25	19
80	91	83	75	68	61	54	47	41	35	29
90	92	85	78	71	65	58	52	47	41	36
100	93	86	80	73	68	62	56	51	46	41
110	93	87	81	75	70	65	60	55	50	46
120	94	88	82	77	72	67	62	58	53	49
140	95	89	84	79	75	70	66	62	58	54

New and Improved Equipment

Speed-Indicating Relay for Remotely Controlled Generators

A speed-indicating automatic relay, designed primarily for use with small, low-speed, vertical waterwheel generators operating under full automatic or remote supervisory control systems. has recently been placed on the market by the Westinghouse Electric & Manufacturing Co. While designed primarily for low-speed operations, it may be used for high-speed applications and on either vertical or horizontal machines.



Relay removed from its housing

The relay is mounted directly on the end of the rotor shaft, which on most waterwheel generators is at the top, and is inclosed in a sheet-metal housing, shown at the left in the figure, having a removable top for inspection. Control current is supplied through five slip rings, circling the relay mechanism and insulated from it by a micarta tube. Through these five rings and their corresponding brushes any desired system of remote or automatic control can be connected.

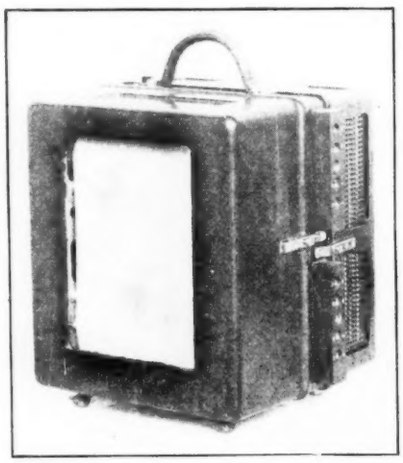
The relay operates on the centrifugal principle and assists other relays and contactors in controlling the station. It has three contact points—starting speed, synchronous speed and above normal cutout speed. When the generator is started, either automatically or by a distant operator, its increasing speed causes a vertically suspended governor weight, held against spring tension in the relay, to move outward, and as the speed approaches synchronism, contacts are closed, completing a circuit, which operates to throw the generator directly on the line.

If, for any reason, conditions of other automatic apparatus are adverse to the generator's being connected to the line, and the breaker is thereby prevented from closing, the generator speed must decrease until the relay contact is established with the initial starting point before it can be started up. This assures safety to both the generator and its main control apparatus by insuring that all starting operations are performed in proper sequence.

After the generator has been successfully connected to the load, should its speed increase to approximately 40 per cent above normal, the third contact in the relay would automatically disconnect the machine, open the field switch and close the gates. The generator's speed must fall to the value of the first contact position before it can be re-energized.

New Line of Recording Electrical Instruments

Two new types of portable curve-drawing instruments have been introduced by the General Electric Co. These instruments are intended for alternating-current work, the first being equipped with a Chelsea-clock paper drive and the second with a Warren motor. With them, chart speeds of one, three, six or twelve inches per hour can be obtained, and all instruments are equipped with a gear shift which changes from inches per hour to inches per minute or vice versa, on either clock or motor-driven charts.



Polyphase curve-drawing wattmeter

The instrument frame is mounted on a main frame to which are hinged front and back covers which form the case of the instrument. The main frame also carries the chart carriage assembly, mercury damper, potential switch and terminals.

The potential resistance is mounted in two ventilated compartments in the back cover and is separated from the instrument proper by bakelite panels. The construction is such that the potential circuit is broken at the terminals when the back cover is open. Persons operating the instruments are thus protected from the high voltages.

The chart carriage is hinged at the bottom and may be tilted forward, thus making it easy to install new charts. All parts of the instruments are easily accessible. The complete line comprises ammeters, voltmeters and single-phase and polyphase wattmeters, and all are self-contained. The voltmeters and potential circuits for the wattmeters are triple rated 110, 220 and 550 volts, and the ammeters and current circuits of the wattmeters are rated up to 20 amperes.

Epco Dust Mask

With a view to providing a workman with clean air for breathing while engaged in dusty work such as cleaning the interior of furnace walls, sandblasting, grinding or other similar work which must be done in a dust-laden atmosphere, the dust mask illustrated herewith has been brought out by the Engineering Products Corporation, Inc., 64 Wall St., New York City.

The hood of the mask is made of strong O.D. twill and is designed to fit over the head and shoulders with liberal allowance for moving the head and arms. The face side of the mask is fitted with two large lenses, a respirator and exhalation valve.

The vision glasses, which are made of clear, two-ply laminated glass, are mounted in aluminum holders secured in the hood by screwed collars. The respirator, through which the breathing is done, is fitted with a fine copper screen and a number of felt filtration pads, the number of disks used being governed by the size and volume of dust particles. It is also fitted with a rubber cushion so designed as to adjust itself readily to the nose and mouth. The respirator is held in place by means

Workman wearing dust mask in boiler furnace

of a tape or strap that fastens around the neck. Exhalation is by means of a flutter valve attached to the bottom of the respirator.

The respirator and lens holders are made removable, which permits the washing or cleaning of the hood or the renewal of the fabric when necessary.

Duplex Water Gage

A boiler-water gage in which two glasses are used in place of one and which is so designed that both glasses can at no time be shut off to the boiler, is a recent development of the Duplex Valve Products, 459 Murray Ave., Milwaukee, Wis. Referring to the illustration, the upper and lower fittings are designed to accommodate duplicate gage glasses and are fitted with valves by means of which either glass is shut off from the boiler. In the event of a glass breaking, the valves close automatically, shutting off the water and steam connections to the broken glass, but leaving the other one in operation. To permit operation of the valves by hand, a valve rod *A* with a lever attached is placed between the glasses and

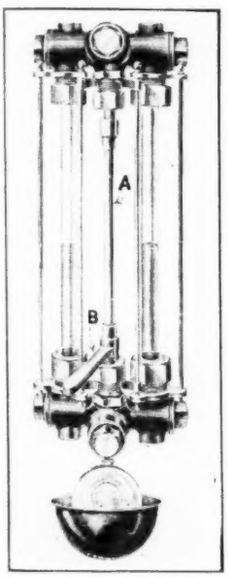


Fig. 1—Duplex water gage

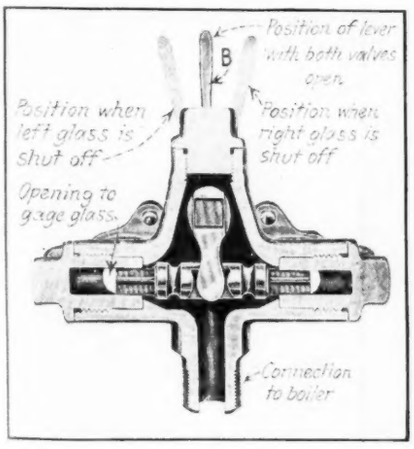

B
Position of lever with both valves open
Position when left glass is shut off
Position when right glass is shut off
Opening to gage glass
Connection to boiler

Fig. 2—Section of fitting showing method of operating valves

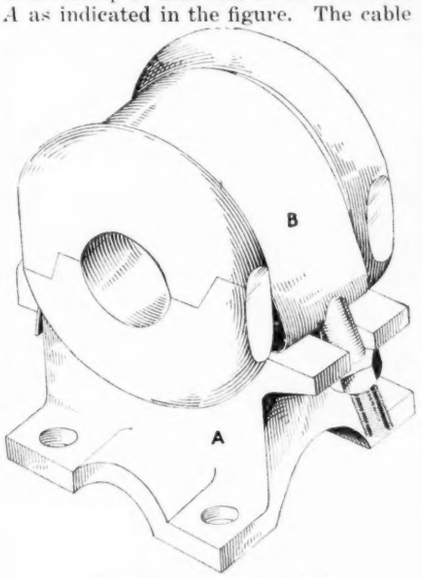
connected to each valve, as shown in Fig. 2. This arrangement closes both valves simultaneously and precludes the possibility of leaving an upper valve shut off and a lower one open, causing the gage to show a false water level. The position of the lever *B* serves to indicate the position of the valves at all times. A baffle is placed behind the valve operating rod *A* to prevent fragments of broken glass from interfering with the opposite gage glass.

Referring to Fig. 2, it will be seen that only one glass can be closed off at one time and that with the valves in the central position, as shown, both glasses will be in operation.

The gage, which is made of heavy bronze and fitted with renewable seats and disks, is adaptable to marine, railroad, stationary and portable boilers.

New Type Bus Support

A device designed to support wires and cables in all kinds of open work and round busbars on the back of switchboards has been brought out by the Electrical Development & Machine Co., Holmesburg Junction, Philadelphia, Pa. This fitting is known as the Franklin Type S Bus Support and is designed for use where mechanical strength is desirable. The clamping device is of a non-magnetic design, consisting of a brass strap *B* attached to an iron base *A* as indicated in the figure. The cable



Bus support assembled

is held between the surfaces of two porcelain semicircular insulators. When lead-covered cables are supported, wooden clamping members are used.

Schutte-Koerting "Radiafin" Generator Air Cooler

A feature of the generator air cooler brought out recently by the Schutte & Koerting Co., Philadelphia, Pa., is the use of oval tubes in place of the round tubes ordinarily used.

The coolers are built in sections, as shown in Fig. 1, suitable for grouping together to form any size of unit. The sections are also designed to permit connecting the water passes in series or parallel as desired.

Fig. 2 is a view of round and oval tubes, with a cross-sectional view of the oval tubes. In the cooler the oval tubes are placed with the long axis parallel to the direction of air flow, and this tends to eliminate the slight vacuum or dead space common to the round tube. It is claimed by the manufacturer that the effective surface of the oval tube is more than double that of a round tube of equal cross-section. This feature permits the use of fewer tubes for a given capacity and therefore reduces the air-pressure drop through the cooler.

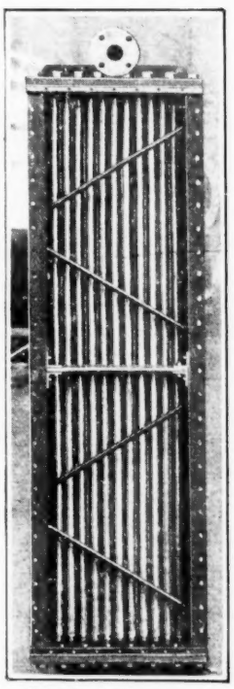


Fig. 1—Section of cooler

The tubes are made of No. 18 B.W.G. Admiralty metal with outside long and short dimension of 1 and $\frac{7}{8}$ in. respectively. Each tube is wrapped with a thin copper fin giving a helical form as shown in Fig. 2.

The tube bundles are rigidly braced with structural-steel members and are closed in on the sides with sheet steel. In Fig 1 the water nozzles are shown on the cover plates, but where desired the heads are supplied with side connection and top cover plates. This latter feature permits the removal of the water-head covers without breaking the pipe connections. For certain installations where the cooling water available

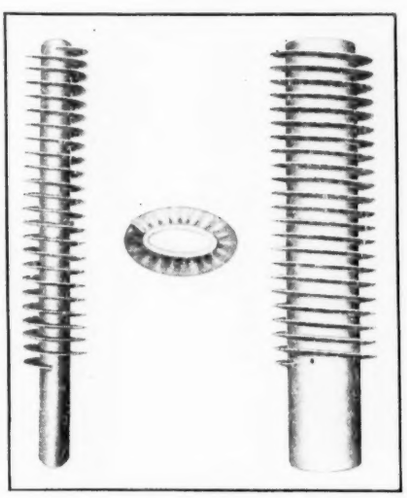


Fig. 2—View of round and oval tubes

is too dirty to permit the use of the oval tube, round tube coolers may be obtained.

The coolers are adaptable for installation in either vertical or horizontal position as best suits the installation requirements.

Power Dam in Wales Bursts

A power dam on Lake Eigian, Wales, burst on Nov. 3, killing at least sixteen persons. The material damage to the dam and power house were comparatively light, although the valley below the dam was completely devastated. The superintendent of the power company is reported as saying that the break could be repaired readily and the power house would be running within a week.

Prompt Measures To Save Niagara Falls Necessary

Active steps are about to be taken by Secretary Hoover in an effort to halt recession of the crest at Niagara Falls. Popular support for the project, which will involve works of some magnitude, is essential if legislation and international authorizations are to be obtained with reasonable promptness, it is believed. The interest in preserving the scenic beauty of the falls is thought to be sufficiently strong to assure the plan of general support from the public, both in the United States and in Canada. As no question of power is to be considered in connection with this effort to prevent further erosion, no great delay or difficulty is in prospect.

Suwannee River May Be Utilized for Power

More electric power appeared within the reach of Jacksonville, Fla., when announcement was made recently in the press by two local men of a project for hydro-electric development on St. Mary's and Suwannee Rivers. The project is expected to produce between 200,000 and 300,000 hp. of energy, through a system of six flood-control and power-plant dams.

Application for preliminary permits for the development of water power from the two rivers, which, if granted, will establish prior rights to dam sites and other privileges, has been made to the Federal Power Commission and a public hearing on the application will be held Nov. 24.

Applicants for preliminary permits are Earnest L. Hill, president of the Earnest L. Hill Realty Co. and C. Lyman Spencer, president of the Southern Development Co. Their application discloses plans to construct three dams on the St. Mary's River and three on the Suwannee River, two of which will be flood controlled and the other four probable locations for hydro plants.

Kefenokee swamp, in south Georgia, the source of the St. Mary's and Suwannee Rivers, is to be the source of power in the project.

G. E. Welding Men Killed in Wreck

In the disastrous train wreck which occurred on the Pennsylvania Railroad near Plainsboro, N. J., on Nov. 12, four members of the General Electric Co. were killed and several injured. The dead include: R. D. Reed, of the industrial department in charge of the sale of electric arc welding equipment; Mark A. Atuesta and Arthur W. Gross, of the manufacturing department, and John C. Horstman, of the manager's staff at the Schenectady plant. Among the injured were D. H. Deyoe, of the industrial engineering department, and Thomas Wry, of the Lynn River Works.

All the men had met in Baltimore in connection with the Interworks welding committee of the G. E. Co. and were en route to the Bloomfield plant when the accident occurred.

Practical Refrigerating Engineers' Convention

A large attendance at the National Association of Practical Refrigerating Engineers, which is to be held at Detroit, Dec. 8-12, is assured. Elaborate plans have been made for the entertainment of the members and guests. A number of speakers who are nationally known, have been engaged to give interesting and inspirational addresses on timely subjects. A number of inspection trips through interesting plants will be made by the delegates and guests during the convention, including the Ford Motor Co.'s plant.

The keynote of the educational program will be maintenance and operation for highest efficiency. The educational sessions will be started with question and answer dialogues on subjects that are of special interest to the operating engineer, and the following subjects will be treated in interesting and instructive papers: "Plant Management"; "Condenser Construction and Operation from the Operator's Viewpoint"; "Compressor Efficiency and Factors Which Effect It"; "Ice Shrinkage from the Freezing Tank to the Platform"; "Ice Storage House Construction and Operation"; "Care, Maintenance and Operation of Cold Storage Equipment"; "Ice Freezing Tank Construction and Operation"; "Construction and Operation of Electrical Equipment for Ice Making and Refrigerating Plants"; "Economical Use and Generation of Steam in Ice Making and Refrigerating Plants"; "Practical Tools and Instruments for the Operating Engineer"; "Care and Treatment of Refrigerating Brines to Prevent Corrosion"; "Maintenance and Operation of Ice Making and Refrigerating Plants for Highest Possible Efficiencies"; "Operation and Management of Car Icing Stations"; "Engineering and Maintenance of Ice Making and Refrigerating Plants"; "The Engineer's Responsibilities to His Work."

Charles W. Chapman, national treasurer, is chairman of the general convention committee. The subcommittees are as follows: Finance, Theodore Huetteman, chairman, James Wise and J. D. McDonnell; exhibits, R. C. Doremus, chairman, William Eberlaine and Hubert Frank; entertainment, Edward M. Johnson, chairman, E. J. Mueller and A. F. Cramer; hotel registration and transportation, Burt C. White, H. L. Campbell and Oscar Stauder.

Carbonizing Saskatchewan Lignite Successful

The carbonizing and briquetting tests with Saskatchewan lignite, carried out during the past summer at two of the largest briquetting plants in Germany, Thyssen & Co., Mulheim-Ruhr, and the Lurgo Co., Frankfort, were technically successful, according to a verbal report by W. G. Worcester, professor of ceramics at the University of Saskatchewan, who personally took charge of the shipment of 52 tons of lignite from the mines of the Western Dominion Collieries at Taylorton and went to Germany to see the tests carried out. The formal report dealing with the various tests will not be ready for some weeks, but the members of the Lignite Utilization Board are pleased with the preliminary report received.

St. Lawrence Power Project Affected by Decision

A recent decision of the Privy Council in the case of the Attorney-General of Quebec versus the Harbor Commission of Montreal, a Dominion body, affirming that the right of ownership of the foreshore and bed of navigable portions of the St. Lawrence is vested in the Province, and that the deep waterway scheme cannot be carried out without the consent of the Quebec Legislature, which is hostile to the idea, will, however, it is pointed out in the press, enable the Province of Ontario to enter into an argument with the State of New York to dam the Upper St. Lawrence for power purposes whether the Dominion Parliament consents or not.

The late Sir Adam Beck asked the Dominion to accord Ontario authority to go ahead with power developments on the Upper St. Lawrence independently of the waterways project. If the Ontario Hydro Commission now desires to pursue the policy advocated by its late head, the way has been cleared by the decision of the Privy Council.

Fifth Annual Report of Federal Power Commission Shows Increasing Importance of Hydro Power

Eighty Applications for Projects Involving an Estimated Installation of 620,000 Hp. Filed During Fiscal Year

THE fifth annual report of the Federal Power Commission for the fiscal year 1925 has just been issued. The report touches on new phases and reiterates the necessity for some amendments to the Act, to the end that there may be a more efficient working of the Commission. It emphasizes the necessity for undertaking a study of the water resources of the streams of the United States. The report briefly and in part is as follows:

"The last five years have witnessed the greatest water-power development in our history. While several factors have contributed to this result, such as increasing fuel costs and the extension of the practice of power-plant interconnections, it can scarcely be doubted that the chief factor has been the Federal Water Power Act — the first federal legislation to offer conditions under which the huge investments necessary for the development of our water powers could safely be made. Approximately 85 per cent of the water power resources of the United States are subject in one form or another to the jurisdiction of the federal government and can be utilized only under the provisions of the Federal Water Power Act. The extent to which this act has aided in development is indicated by the applications filed, the permits and licenses issued, and the construction completed or under way.

"During the fiscal year 1925, applications for 80 power projects were filed involving an estimated installation, if built, of 620,000 hp. and 32 applications for transmission lines. During the year 18 permits and 53 licenses, with an estimated installation of 1,766,000 hp. were issued. At the end of the year there were outstanding 70 permits and 180 licenses aggregating 8,745,000 hp. Eighty-three projects with a prospective installation of 2,646,000 hp. had been completed or were under construction, 10 of which, with a combined installation of 197,500 hp., had been started during the year.

Amendments to the Act

"The constantly increasing number of applications requiring examination and report, the general supervision over projects under license, and the checking of records and examination of accounts incident to the determination of costs of construction and of net investment have placed an obligation upon the Commission which it has become practically impossible to carry out satisfactorily with the limited staff it has been able to borrow from the departments."

The report continues: "An amendment of the Rivers and Harbors Act of the 68th Congress provides for the submission by the Secretary of War and the Federal Power Commission of an estimate of the costs of the surveys necessary to draw up a comprehensive plan of river development. This report will be presented to the next Congress. Whatever may prove to be the costs of such surveys, they should be undertaken in order that we may avoid the mistakes in the development of our rivers that will inevitably follow the absence of definite plans.

"The Commission repeats its previous recommendations that its activities be placed upon a business basis, and that the moneys collected for paying costs of administration and for the use of government dams be placed in a special fund to be used for paying such costs and for conducting surveys and preparing comprehensive plans of river development.

"Certain activities of the Commission, particularly those relating to matters of accounting and of valuation, parallel similar activities of state commissions and have led to a constantly increasing degree of co-operation between the state and federal commissions. This has resulted not only in mutual assistance but in the avoidance of duplication of work and of records.

Interstate Power Transmission

"Few water-power sites are in the immediate vicinity of the markets to be supplied with power. The long-distance transmission frequently required to bring the developed energy to the point of use, and the interconnection of hydro plants with steam plants over large areas to form so-called 'superpower systems' has naturally brought about interstate transmission of electric energy. The number of such interstate transfers will constantly increase.

"At the present time the volume of energy transmitted across state lines is a small part of the total volume of electric energy generated and distributed, and while the proportion will increase in the future, it is not probable that it will ever be more than a small fraction of the total. Its importance, however, in individual cases, and its relation to the general question of public-utility regulation may be far greater than the ratio of the amount of such interstate transfers to the total energy used. A considerable part of the electric energy supplied to the City of Baltimore, for example, is generated in the State of Pennsylvania and wholesaled across the state line to a Maryland distributing company. There is a proposal to develop a large hydro-electric plant in the lower Susquehanna River in Maryland and to wholesale the greater part of the output to a Pennsylvania distributing company for use in the City of Philadelphia. If disposition is eventually made of the government project at Muscle Shoals a considerable part of the energy output is likely to be wholesaled to distributing companies in neighboring states. Any development and use of the St. Lawrence powers will involve interstate energy transfers aggregating hundreds of thousands of dollars. A similar situation will exist if the problems of the Columbia and Colorado are ever settled. The public interests at stake will be too great to be waved aside as inconsequential, and it becomes important to determine whether and by whom these interstate energy transfers are to be regulated."

Russia Plans To Spend Large Sums in Machinery

According to a report published in the *New York Times*, Soviet Russia expects to expend considerable amounts in machinery during the coming year. The report states that $160,000,000 for various kinds of machinery will be spent and $2,000,000,000 in the following five or six years. Among the kinds of machinery needed are mining, oil and coal equipment, as well as electrical equipment.

Des Moines' New Power Plant Started

The first unit of the new Ball's Ford generating plant of the Iowa Power & Light Co., southeast of Des Moines, Iowa, was recently put in operation, with a formal opening and an opportunity to the public to inspect it. This plant and the new plants at Davenport and Sioux City will together increase Iowa's power resources nearly 25 per cent. The Des Moines plant cost $7,000,000 and has an initial rating of 60,000 kva.

New Steam Plant for Dublin, Georgia

The Georgia Southern Power Co., organized not long ago and owned and operated by the Interstate Utilities Corp. of Washington, D. C., recently acquired the municipal steam electric plant at Dublin, Ga., and plans are being prepared to build a large central station at this point to serve Dublin and other cities in southeastern Georgia. Negotiations have been completed or are still pending for the purchase of several other properties, which will all be interconnected and served from the generating plant at Dublin.

Brooklyn Edison Plant Has Trouble with Fish

The Sixty-sixth Street power plant of the Brooklyn Edison Co. in Bay Ridge, Brooklyn, N. Y., was almost put out of operation on Nov. 18, when a huge run of fish, called lafayettes, through the Upper Bay became jammed against the condenser tubes. Thousands of these fish were forced past the sides of the screen and were carried through the submarine tunnels into the condenser.

When the trouble and its nature was discovered, the generators were stopped one at a time, and crews were sent into the condensers to shovel out the fish. More than two tons were removed, and the screens were in the meantime reinforced.

Survey of Water Resources by Geological Survey Desired

Impressive support has been marshalled by American Engineering Council for its bill proposing a complete inventory of the nation's water resources. The wide interest displayed in the subject and the fact that a report on a general survey of rivers will be made to the next Congress, insure, at least, committee consideration of the matter.

On behalf of the legislation that has been drafted by American Engineering Council it will be argued that the United States Geological Survey for more than thirty years has conducted systematic surveys of water resources and is the best fitted government agency to undertake the proposed work. The methods and instruments developed by the Survey for conducting water resources investigations have been accepted as standard throughout the world, it is claimed. Other arguments that will be advanced in support of American Engineering Council's bills, in substance, are as follows:

The Geological Survey is primarily a bureau of research and investigations that collects systematically and publishes for general information and use data concerning the natural resources of the country. The sporadic investigational work with respect to water resources done by other government bureaus is commonly intensive rather than extensive, being undertaken for the benefit of specific local projects; it is lacking in system and continuity; the methods are not standardized; and the results, seldom available, are only of incidental value in planning for comprehensive development.

It is highly important that the proposed inventory of water resources be made by an agency that is not directly interested in construction or administration of specific projects or of specific types of projects and that may therefore be regarded by the public with confidence as impartial in its investigations. Moreover, agencies having responsibility for construction or administration are most soundly fortified if their actions are based on information collected by an accredited federal investigational bureau whose primary responsibility is that of making available unbiased facts.

Congress has made specific appropriations for water resources investigation by the Geological Survey since 1895 and the extension of these investigations to meet present demands requires that these specific appropriations must be enlarged. Funds collected from licensees of the Federal Power Commission or from other sources are not available for these investigations.

As a result of specific appropriations the Geological Survey, with its limited funds, has already collected records of flow of over 5,000 gaging stations on the principal rivers of the United States. Data for over 25,000 record years are available for these stations. Surveys covering over 16,000 miles of river channel have been made which show by contours the principal topographic features along the rivers and detail topography of reservoirs and power sites.

The Chief of Engineers and the Secretary of the Federal Power Commission are expected to oppose the bill.

Bureau of Mines To Make Coal Stock Survey

Plans for a survey of coal stocks by the United States Bureau of Mines as of Nov. 1 have been made, according to recent announcements. The machinery is in motion and the figures will be available, according to general opinion, shortly before Christmas.

Government Needs Young Draftsmen

The United States Civil Service Commission, Washington, D. C., announces an open competitive non-assembled examination for junior mechanical draftsman, junior electrical draftsman and junior engineering draftsman to fill vacancies in the federal classified service throughout the United States, including the departmental service in Washington, D. C.

New Delaware Plant's First Unit Put on Line

The first unit of the new Delaware generating plant of the Philadelphia Electric Co., located on the Delaware River between Lewis St. and Erie Ave., was connected on Nov. 17 with the rest of the company's system.

Joseph B. McCall, chairman of the Board of Directors, linked the plant with the others in the presence of other officials of the company.

The first generating unit of 50,000 kw. was completed a few days ago. It will be one of twelve with rated capacity of 600,000 kw. and, when completed, the system will constitute the largest steam generating plant in the world.

When the twelve units of the station are operating at capacity, it will be producing more electricity than is now being made by water power at Niagara Falls. The station's production ultimately will exceed that of Muscle Shoals' rated capacity.

The buildings to house the generators will be the largest in ground area in this city. When completed, 5,000 tons of coal will be used daily.

James Hunt, formerly superintendent of the Schuylkill plant, at 28th and Christian Sts., will be the superintendent.

Among the officials who watched Mr. McCall connect the unit were: Walter H. Johnson, president of the company; W. C. Eglin, vice-president in charge of engineering, and H. P. Liversidge, vice-president and assistant engineer.

Sesqui Gets Another New Start

Mayor Kendrick, of Philadelphia, has again changed his plans for the Sesqui-Centennial celebration, announcing on Nov. 16 that two more major buildings for the Sesqui exhibition, would be erected. These buildings were included in the former plan, which he recently decided to abandon.

The two buildings are the Palace of Machinery, Engineering, Mines, Metallurgy and Transportation and an Auditorium that will seat 20,000 persons. The Mayor is quoted in the press as saying that the contract for these two buildings will probably be let during the coming week.

The new exhibit building, which will cost approximately $1,250,000, will be divided into two sections, one devoted to machinery and engineering, the other to mines and metallurgy, transportation on land and air, and will be 1,888 ft. long by 400 ft. tapering width.

The exhibits will contain, according to the report from the Sesqui headquarters, a large and comprehensive showing of Diesel engines, the history of development of the Diesel from its earliest days to the present time, including stationary and marine types, also the new Diesel-drive locomotive manufactured by the Baldwin Locomotive Works. Eight of the Diesel manufacturers are to have important displays it is reported. They will show direct-connected Diesel-engine generator sets ranging in size from 350 to 1,000 hp. each. The Diesel engine manufacturers who have engaged space will generate a total of 7,500 hp. and there will be one 1,000-hp. set coming from Germany and another from Switzerland.

Power for driving the machinery in the exhibit buildings will be developed with the exhibits of the manufacturers in actual operation. One turbine manufacturer will have a steam turbine direct connected with the generating set for power use. Three unaflow engines will be shown in operation, it is stated.

New and important departures in ice making and refrigeration will be shown, it is said. The burning of powdered coal will be the main feature of a number of manufacturers. Boiler and stoker manufacturers have also arranged for space, as well as some steam specialty manufacturers.

Production, Imports, Stocks, Exports and Domestic Consumption of Refined Gas and Fuel Oil and Lubricating Oil

	Barrels of 42 Gallons					
	Gas and Fuel Oil			Lubricating Oil		
	Aug., 1925	Sept., 1925	Sept., 1924	Aug., 1925	Sept., 1925	Sept., 1924
Production	33,440,000	30,499,000	26,521,699	2,668,000	2,565,000	2,148,277
Daily average	1,078,710	1,016,633	884,057	86,065	85,500	71,609
Imports	968,000	652,000	575,248	4,000	1,000	36
Daily average	31,226	21,733	19,175	129	33	1
Stocks:						
End of month	Not available	Not available	39,061,965	6,727,000	6,760,000	5,789,267
Increase during month	Not available	Not available	d 430,201	d 120,000	33,000	9,436
Daily average	Not available	Not available	d 14,340	d 3,871	1,100	314
Exports	2,523,000	2,808,000	3,462,867	872,000	563,000	591,801
Daily average	81,387	93,600	115,428	28,129	18,767	19,727
Indicated domestic consumption	Not available	Not available	24,064,281	1,920,000	1,970,000	1,547,076
Daily average	Not available	Not available	802,144	61,936	65,666	51,569

d Denotes decrease.

New Plant for Tri-Cities Opened

The formal opening, which included four days of "open house," of the United Light & Power Co.'s Riverside plant at Bettendorf, near Davenport, Iowa, was held during the last week of October. This station has an initial installation of 25,000 kw. and cost about $2,500,000. It is to serve the cities of Davenport, Iowa, Moline and Rock Island, Illinois.

Low Carbonization Practice Not Favored

At the Fifth Congress of Industrial Chemistry, which was held in Paris, Oct. 4-11, there was a discussion on low-temperature carbonization in two of the papers; one by Charles Berthelot and the other by Edgar C. Evans. Neither speaker sponsored the present practice in low-temperature carbonization, both seeming to imply that a compromise between high- and low-temperature carbonization was more sound economically at the present time.

Oil Conservation Board Asks More Information from A.P.I.

The Secretary of the Interior, as chairman of the President's Federal Oil Conservation Board, has again appealed to the American Petroleum Institute for the benefit of its conclusions respecting the conservation aspect, both of production and consumption, of oil. The letter says: "The subject of conservation particularly stressed in the President's letter of Dec. 19, 1924, appointing the Federal Oil Conservation Board is barely mentioned in the book entitled, 'American Petroleum Supply and Demand,' and refers solely to improved refinery practice and more efficient utilization of refined products."

Colorado River Report Issued by Government

A comprehensive report on the Colorado River as a result of engineering studies by the Geological Survey has just been issued. The author is E. C. LaRue, hydraulic engineer, who has made a study of the river during the last 15 years, in the course of which he has made boat trips aggregating nearly 2,000 miles along the river and its major tributaries, including the whole of the Grand Canyon.

The report, which is published as Water-Supply Paper 556, deals with the comprehensive development of Colorado River below the mouth of Green River, with particular reference to flood control and the development of hydroelectric power. Records of stream flow are summarized, and estimates of water supply available at many points under a variety of conditions are presented. The principal reservoir sites are described, and their availability and usefulness are discussed. Plans, cross sections, and area and capacity curves, together with engineering and geologic discussions, are presented for all known dam sites on nearly a thousand miles of river, all of which has been surveyed and mapped.

Catalogs Wanted for the New Zealand Exposition

Managers of the International Exposition which opens on Nov. 12, at Dunedin, New Zealand, and is to continue for five months, are calling for manufacturers' catalogs for distribution. These should give lowest c.i.f. quotations, or quotations on the basis of f.o.b. steamers Atlantic or Pacific ports. American manufacturers and exporters, who do not feel prepared to undertake the expense of exhibiting at this far-distant center, are thus offered an opportunity to introduce their goods. Catalogs should be addressed direct to the Exhibition Grounds, Dunedin, New Zealand, attention of exhibition committee.

Rentals for Barge Canal Water Fixed

The New York State Water Power Commission has fixed the rental charge for the use of surplus waters of the Canal at Rochester Harbor of the Rochester Gas & Electric Corp. at $50,000 annually.

It also determined the rental charge for the use of surplus waters of the Barge Canal at Medina, a joint application for the use of which was made by S. A. Cook & Co., Inc., and the Western New York Utilities Co., Inc., at $10,000 annually. Hearings will be held Dec. 10.

The commission granted a preliminary permit to the Lower Niagara River Power & Water Supply Co., conditioned upon the acceptance by that company within thirty days from date, covering the use of water power in the Niagara Gorge.

President Considering Two Muscle Shoals Reports

The President now has before him the reports of the Muscle Shoals Commission. While no part of the reports has been made public, it is understood the majority proposition follows the general line of the plan proposed in the Underwood Bill, which failed in the last Congress. It is sponsored by Chairman McKenzie and Commissioners Dial and Bower. The minority report, signed by Commissioners Curtis and McClellan, is thought to advocate complete separation of fertilizer and power activities; they oppose subsidy in any form or to any extent for fertilizer manufacture and are opposed to the government's entering the fertilizer business.

On receiving the majority report, the President referred it to the Secretaries of War, Commerce and Agriculture, since the majority members had not complied with his desire that they confer with those Cabinet officers in the formulation of their conclusions.

While each of the minority members has opposed hidden subsidies for fertilizer, it is certain that they have favored its manufacture on any sound economic basis. The President is expected to refer briefly to Muscle Shoals in his message at the opening of Congress. Later, he is expected to communicate with Congress more at length on the subject. In the meantime, he expects to make public the two reports.

Coal Association To Start Research Program

The National Coal Association decided at a conference held recently, to form a research committee, with Walter Barnum as chairman, to study the subjects that seem most important. Subcommittees have been formed to study the following subjects: Oil competition; possibilities of servicing heating and power plants including domestic heating plants, with report on physical conditions as they exist and direct results that should be obtained, and indirect results likely as to local and national good will; increased summer coal consumption, with special reference to artificial refrigeration and systems for providing lower summer temperatures for office buildings, theaters, homes, etc.; preparation, washing and screening; pulverizing coal methods, costs and adaptability; distillation, etc.

Unusual Cables Will Carry Power From Cushman Plant

Spanning a distance of 6,240 ft. six cables are to be strung across an arm of Puget Sound into Tacoma. These cables will eventually carry the 140,000 hp. generated at Tacoma's new $5,000,000 hydro-electric plant.

The two steel towers rising on each side of the "Narrows," are 311 ft. high. Standing on the edge of the cliff, they are 617 ft. above the water.

The cables are 1¼ in. in diameter, manufactured from plow steel. Each is 9,000 ft. long, to allow for sagging and anchorage. At high tide the lowest part of the cables will be 200 ft. above the water, allowing the largest vessels to pass under.

Each tower will carry three cables. No messenger cables are being used, each conductor carrying its own weight. All smaller towers and poles are set and wiring completed for the 44-mile line from the Cushman plant to Tacoma. This double transmission system will cost about $825,000.

Special Water Power Tax in Porto Rico To Be Fought

Considerable objection has developed to the law recently put into effect in Porto Rico which provides for an annual levy of a special tax of one-tenth of 1 per cent of assessed valuation of all taxable real property for the purpose of development of water power, as noted in *Power* Sept. 9, page 382.

It is reported that the Porto Rico Railway, Light & Power Co., of San Juan, is planning to attack the constitutionality of the act in the courts. A hydrographic survey of the island, authorized in the 1923-25 budget, is now under way, and the proceeds of the tax are to be used in developing sources of water power disclosed by this survey, preference to be given to those promising the largest output. A clause in the act reads as follows:

"That whereas the enactment of this bill by the Legislature determines a new policy in the utilization of public waters by the people of Porto Rico, it shall be the duty of the Public Service Commission to see that said policy is not impaired by grants of franchises."

Occee River Plant To Be Enlarged

The Tennessee Electric Power Co., a subsidiary of the Commonwealth Power Corp., is to build a reservoir to cost $3,000,000 at Blue Ridge, Ga. The development on which about $1,500,000 will be spent next year will generate about 22,000 hp. and will increase the capacity of the present Occee River plant by about 80,000,000 kw.-hr. annually.

Hot-Water Springs Used To Heat School

A $75,000 school building has recently been erected at Pagosa Springs, Colo., in which a natural hot-water spring is being utilized for heating purposes. The water, which flows with the force of an artesian well, was found at a depth of 383 ft. The initial temperature was 116 deg. F., but after a few days it registered 118 deg. and has a 65-lb. pressure. The water rises to the roof of the two-story building, where gas adjusters regulate the gas pressure which is always present in hot-water springs. The results are reported as being satisfactory.

Power Show To Be Larger Than Last Year

The Fourth National Exposition of Power and Mechanical Engineering which is to be held in New York City during the week of Nov. 30-Dec. 5, will have 400 exhibitors as compared to 350 last year, and the record of last year's 80,000 visitors will probably be exceeded.

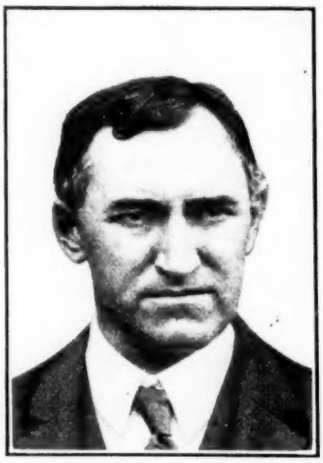
A program of speakers for the benefit of students of engineering is as follows: "Steam Prime Movers," by C. Harold Berry, editorial staff of *Power;* "Oil and Gas Engines," George A. Richardson, Bethlehem Steel Co.; "Steam Boilers," E. R. Fish, Heine Boiler Co.; "Industrial Power Plants," F. M. Gibson, American Sugar Refining Co.; "Hydraulic Machinery," W. M. White, Allis-Chalmers Co.; "Heating and Ventilating," by S. E. Dibble, A.S.H.&V.E.; "Standardization," by C. E. Skinner, A.E.S.C.; "Steam Locomotives," by Clair B. Peck.

An excellent program of motion pictures includes: "A Forward Step in Stoker Performance," Riley Stoker Corp.; "From Mine to Consumer, the Story of Anaconda," American Brass Co.; "The Story of Brass and Copper," Mueller Brass Co.; "Power, Its Generation in Big Engines of Yesterday and Today"; "The Construction of the Weymouth Power Station," Stone & Webster Co.; "Saving Coal at Home," United States Bureau of Mines; "The Story of a Motor Truck," United States Bureau of Mines; "The Story of Asbestos," United States Bureau of Mines and Johns-Manville, Inc.; "Water Power," United States Bureau of Mines and the Westinghouse Electric & Manufacturing Co.; "The Development of the Locomotive"; "Building a 50,000-Hp. Steam Turbine Generator"; "Ships, From Sailing to Steam and Electric Motor Ships"; "Five Big Mechanical Jobs"; "Mining and Preparation of Anthracite Coal"; "Mining Methods and Preparation of Bituminous Coal," General Electric Co.; "Refining, Production and Manufacture of Monel Metal," International Nickel Co.

J. F. Johnson, Steam Turbine Engineer, Dies Suddenly

The associates and friends of Josiah Francis Johnson, chief engineer of the South Philadelphia works of the Westinghouse Electric & Manufacturing Co., were shocked to hear of his sudden death in the Chester hospital on Nov. 12. Death was caused by a cerebral hemorrhage.

Mr. Johnson was born July 15, 1879 at Ziongrove, Schuylkill County, Pa., and was graduated from the Bloomsburg High School and later from the



Josiah Francis Johnson

Bloomsburg Normal School. Following this, he spent some time as a railroad telegraph operator, and at another period taught school. He then entered the Pennsylvania State College, from which he was graduated in 1905 with honors. He and one other held the highest class record, and for this proficiency the white gold medal was conferred upon him. Following his graduation, he entered the employ of the Westinghouse company, East Pittsburgh, and until 1906 was engaged in the shop testing of steam turbines. From this he was promoted to service work, and in 1910 he was field engineer and engaged in the erection, inspection and repair of steam power machinery. From 1910 until 1912 he was assistant district engineer with offices in New York, and district engineer of the Rocky Mountain district with offices at Denver, Colo., where he had full charge of all installation, inspection and repair of all steam power apparatus in that territory. His ability in these activities caused him to be recalled to the East Pittsburgh plant, where in 1912 he assumed the duties of first assistant engineer of the steam turbine department, subsequently becoming engineer of the turbine department, which position he held until 1923, when he assumed a new duty as manager of the general engineering division. This position he held until his death.

Throughout Mr. Johnson's career he has invariably shown marked ability and untiring zeal, always having the courage of his convictions and was beloved by all his associates. He was a valued contributor to *Power*.

In 1915 Mr. Johnson married Irene Mercer, of Bloomsburg, who survives him, as does also a son, Frank, and two older brothers, William Peirce Johnson, of Nescopeck, and Charles Franklin Johnson, of Hughesville, Pennsylvania.

Society Affairs

The Affiliated Technical Societies of Boston are to hold a two-day meeting Dec. 10-11 on "Fuel and Power for the Industries and the Home." Papers for the sessions will cover: "Sources and Utilization of Fuels," "Requirements of Power in the Industries," and "Operating Practice."

A Conference of the Engineering Profession of Michigan has been called for Feb. 4-5 at the Hotel Tuller, Detroit, Mich. Eighteen organizations, twelve in Detroit and six in the state, have signified their intention of participating in the conference. Herbert Hoover, John R. Freeman, L. W. Wallace, Charles F. Kettering and others have been invited to speak.

The Philadelphia Section of the Association of Iron and Steel Electrical Engineers will hold an important meeting on Dec. 5 at the Rajah Temple, Reading, Pa. E. J. Poole, general superintendent of the Carpenter Steel Co., will speak on "Economies That Have Been Effected at The Carpenter Steel Co. During the Last Decade." James A. Powell, mechanical engineer with the W. S. Barstow Management Association, Inc., will speak on the "Design and Test of the Susquehanna Station of the Metropolitan Power Co. at Middleton, Pa."; the performance of the boiler plant and the main turbo-generator, condenser and bleeder heaters as well as coal preparation and reasons for adoption of pulverized fuel will be discussed in the speech.

Business Notes

The Wickes Boiler Co., Saginaw, Mich., announces the election of Edward B. Wickes as vice-president and the appointment of Henry E. Aldrich as general sales manager of the company.

McClave-Brooks Co., Scranton, Pa., has recently purchased the McKenzie Furnace Co. and will handle a complete line of stokers which will include a natural-draft and a forced-draft chain-grate stoker for bituminous coal, and for anthracite both a forced-draft traveling-grate and a forced-draft chain-grate stoker. The two bituminous stokers will continue to carry the name "McKenzie," while the anthracite stokers will carry the name "McClave," although all will be built by McClave-Brooks Co.

The Fulton Iron Works Co., 1259 Delaware Ave., St. Louis, Mo., has organized a new corporation under the laws of Delaware, known as the Fulton Finance Co. This new corporation will enable the Fulton Iron Works Co. to extend the credits and to render a greater service to its customers.

The Midwest Air Filters, Inc., and the **Midwest Steel & Supply Co.**, have removed their headquarters from 100 East 45th St., New York City, to Bradford, Pa., where the factory is located. A branch sales office will be retained at the former New York City address.

The Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill., announces that it has moved its Sydney, New South Wales, office from 3 Martin Place, where it has been for the last fifteen years, to the Kemble Bldg., Margaret St. The Cleveland office of the company has been moved from room 701 to Room 1506 of the Rockefeller Building.

The Roller-Smith Co., 233 Broadway, New York City, announces that its Knoxville, Tenn., agent, the Tennessee Engineering & Sales Co., has opened a branch office at 493 North Boulevard, Atlanta, Ga., and all Georgia business will be looked after from the Atlanta office; that its New England agent, the Detweiler-Bell Co., now has its main office at 101 Milk Street, Boston, Mass., and has a branch office at 152 Temple St., New Haven, Conn., and that Paul G. Detweiler and R. H. McCormick are located in the Boston office and F. M. Lord in the New Haven office.

Trade Catalogs

Switch, Change-Over—The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. A bulletin that describes Type M Automatic Change-Over Switch has just been issued by the company.

Buildings, Industrial—The Austin Co., engineers and builders, 16112 Euclid Ave., Cleveland, Ohio. Catalog No. 20, "The Austin Book of Buildings," describes and illustrates the modern trend in the design, construction and equipment of industrial and commercial buildings.

Compressors, Pumps, Etc.—The Pennsylvania Pump & Compressor Co., Easton, Pa. Bulletin No. 125 "General Products Bulletin," covering the compressors, pumps and general lines carried by this company, is now ready for distribution. Illustrations and tables of sizes and capacities add to its usefulness.

Hoists—The Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. A new bulletin has been issued by this company describing the "Turbinair" portable hoists, Type "HA-3" and "HA-2" single-drum and Type "HDA-2" double-drum. The bulletin is well illustrated with pictures of these hoists and their installations.

Instruments, Portable—The General Electric Co., Schenectady, N. Y. Bulletin GEA-158 is devoted to the description of portable instruments. Type "DP-2," direct current, and Type "P-3" alternating and direct current, are the types with which this bulletin is mainly concerned. It is well illustrated and contains information for ordering the equipment.

Recorder, CO_2—Uehling Instrument Co., 473 Getty Ave., Paterson, N. J. Bulletins No. 118 and 118-A have recently been issued by this company to describe the Apex CO_2 Recorder for recording and indicating.

Circuit Breaker—The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Type "CL" carbon circuit-breakers designed especially for 250-volt industrial applications are described in Circular 1705-A. The circular describes in detail the functions of the breaker contacts and outlines the characteristic of effective shock absorbtion, adjustment and equalization of brush pressure and overload attachments.

Coming Conventions

American Association for the Advancement of Science. Burton E. Livingston, Smithsonian Institute, Washington, D. C. Annual meeting at Kansas City, Dec. 28-Jan. 2.

American Institute of Chemical Engineers—Dr. J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y. Annual meeting at Sinton Hotel, Cincinnati, Ohio, Dec. 2-5.

American Institute of Electrical Engineers. F. L. Hutchinson, 29 West 39th St., New York City. Convention at Engineering Building, New York City, Feb. 8-12.

American Institute of Mining & Metallurgical Engineers. Dr. H. Foster Bain, 29 West 39th St., New York City. Annual meeting at Engineering Societies Bldg., New York City, Feb. 15-17.

American Petroleum Institute—R. L. Welsh, 250 Park Ave., New York City. Annual meeting at Biltmore Hotel, Los Angeles, Calif., Jan. 19-21.

American Society of Civil Engineers. George T. Seabury, 29 West 39th St., New York City. Annual meeting at New York City, Jan. 20-22.

American Society of Heating & Ventilating Engineers. F. C. Houghten, 29 West 39th St., New York City. Annual meeting at Hotel Statler, Buffalo, N. Y., Jan. 27-29.

American Society of Mechanical Engineers—Calvin W. Rice, 29 West 39th St., New York City. Annual meeting at New York City, Nov. 30-Dec. 4.

American Society of Refrigerating Engineers, William H. Ross, 154 Nassau St., New York City. Annual meeting at New York City, Nov. 30-Dec. 2.

Association of Municipal Electric Utilities. S. R. A. Clements, 190 University Ave., Toronto, Canada. Convention at Toronto, Ont., Jan. 27-28.

Eastern Ice Manufacturers Association. W. H. Ross, 35 Warren St., New York City. Convention at Hotel Chelsea, Atlantic City, Nov. 23-25.

Iowa Engineering Society. J. S. Dodds, Box 202, Ames, Iowa. Convention at Mason City, Iowa, Jan. 27-29.

Master Boiler Makers Association. Harry D. Vought, 26 Cortlandt St., New York City. Annual convention at the Statler Hotel, Buffalo, N. Y., May 25-26.

Midwestern Engineering Exposition, Inc. George E. Plisterer, 53 West Jackson Boulevard, Chicago, Ill., general manager. Exposition and power show to be held in Chicago, Jan. 26-30.

National Association of Practical Refrigerating Engineers, Edward H. Fox, 5707 West Lake St., Chicago, Ill. Sixteenth annual convention and educational exhibition at Statler Hotel, Detroit, Mich., Dec. 8-12.

National Exposition of Power & Mechanical Engineering. Fred W. Payne and C. F. Roth, Managers, Grand Central Palace, New York City. Exposition at Grand Central Palace, Nov. 30-Dec. 5.

National Marine Engineers Beneficial Association. George A. Grubb, 313 Machinists Bldg., Washington, D. C. Convention at Washington, D. C., Jan. 18.

National Research Council, Engineering Division. William Sparagen, 29 West 39th St., New York City. Fifth annual meeting at Washington, D. C., Dec. 3-4.

Society of Automotive Engineers. Coker F. Clarkson, 29 West 39th St., New York City. Annual meeting at the General Motors Bldg., Detroit, Mich., Jan. 26-29.

Western Association of Electrical Inspectors. W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill. Meeting at Hotel Sherman, Chicago, Ill., Jan. 26-28.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; *mine run* except Pittsburgh gas slack:

Bituminous, Net Tons	Market Quoting	Nov. 16 1925
Pool 1	New York	$2.75@$3.00
Smokeless	Boston	2.24
Clearfield	Boston	1.90@ 2.25
Somerset	Boston	2.00@ 2.40
Kanawha	Columbus	1.55@ 1.85
Hocking	Columbus	1.50@ 1.85
Pittsburgh	Pittsburgh	2.10@ 2.25
Pittsburgh gas slack	Pittsburgh	1.40@ 1.50
Franklin, Ill.	Chicago	2.25@ 2.50
Central, Ill.	Chicago	2.15@ 2.25
Ind. 4th Vein	Chicago	2.25@ 2.50
West Ky.	Louisville	1.25@ 1.50
S. E. Ky.	Louisville	1.50@ 1.75
Big Seam	Birmingham	1.60@ 1.75
Anthracite, Gross Tons		
Buckwheat No. 1.	New York	$2.50@$2.75
Buckwheat No. 1.	Philadelphia	2.50@ 3.00
Birdseye	New York	....

FUEL OIL

New York—Nov. 19, light oil, tank-car lots; 28@34 deg. Baumé, 4¾c. per gal.; 36@40 deg., 5c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Nov. 3, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.90 per bbl.; 26@28 deg., $1.95 per bbl.; 28@30 deg., $2.00 per bbl.; 30@32 deg., $2.05 per bbl.; 32@36 deg., gas oil, 5¼c. per gal.; 38@40 deg., 6c. per gal.

Pittsburgh—Nov. 12, f.o.b. local refinery; 30@34 deg., fuel oil, 5½c. per gal.; 36@40 deg., fuel oil, 5¾c. per gal.

Dallas—Nov. 14, f.o.b. local refinery; 26@30 deg., $1.45 per bbl.

Philadelphia—Nov. 12, 27@30 deg., $2.31@$2.37 per bbl.; 18@22 deg., $1.70@$1.76; 13@19 deg., $1.60@ $1.66 per bbl.

Boston—Nov. 16, tank-car lots, f.o.b. heavy oil, 12@14 deg. Baumé, 4¼c. per gal.; light oil, 28@32 deg. Baumé, 5¾c. per gal.

Cincinnati—Nov. 10, tank-car lots, f.o.b. local refinery, 24@26 deg., Baumé, 6¼c. per gal.; 26@30 deg., 6¼c. per gal.; 30@32 deg., 6½c. per gal.

Chicago—Nov. 10, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.30 per bbl.; 26@30 deg., $1 35; 30@32 deg., $1.40.

New Plant Construction

Ala., Montgomery—Atlantic Ice & Coal Corp., Washington St. Viaduct, plans remodeling plant No. 3 on Bell St., here. Estimated cost $100,000. Equipment will be required.

Ark., Helena — Helena Wharf Improvement Dist., c/o Chamber of Commerce, will soon receive bids for the construction of a river terminal, warehouse, etc. Estimated cost $375,000. Loading and unloading equipment will be required.

Calif., Long Beach—Condit-Woodley Co., J. M. Post, V. Pres., Virginia Hotel, plans the construction of a factory and refrigeration plant on harbor front.

Calif., Manteca — Pacific Gas & Electric Co., 245 Market St., San Francisco, plans the construction of a power plant, here, in connection with Melones dam project for Oakdale and South San Joaquin Irrigation districts, Oakland and Manteca. Estimated cost $1,500,000. Company engineers in charge.

Calif., Reedley—A. Shaw, City Supt., is having plans prepared for the installation of an auxiliary gasoline pumping plant, 250 g.p.m. capacity.

Calif., Sacramento — Arden School Dist., E. A. Crockett, Clk., P. O. box, 901 Route 5, is receiving bids for the construction of a 75 g.p.m. pumping plant against a total head of 75 ft. including a 1¼ in. centrifugal pump direct connected to a 5 hp., 3 ph., 60 cycle, 220 v. induction motor.

Calif., San Francisco—California Poultry Co., Inc., 315 Washington St., awarded contract for the construction of a 5 story poultry warehouse and market addition to P. J. Walker Co., Sharon Bldg. $150,000. Refrigeration plant will be installed.

Calif., San Francisco—Hunter-Dulin & Co., 256 Montgomery St., plans the construction of a 25 story office building at Sutter and Montgomery Sts. Estimated cost $5,000,000. Schultz & Weaver, Pacific Mutual Bldg., Los Angeles, are architects.

Calif., San Francisco — Syndicate c/o L. T. Samuels, 55 Montgomery St., plans the construction of an amusement centre including ice skating rink, etc. at Mission and 16th Sts. Estimated cost $1,000,000.

Colo., Pueblo — Southern Colorado Investment and Development Co., awarded general contract for the construction of a 4 story office building at 4th and Main Sts., to Windsor & Lund, Guardian Trust Bldg., Denver. Estimated cost $500,000.

Fla., Plant City—Arctic Ice Co., J. B. Porter, Supt., plans the construction of a 30 ton electrically operated ice plant. Estimated cost $50,000.

Fla., Tampa—Tampa Arctic Ice Co., c/o A. L. Burford, Secy., is having plans prepared for the construction of a 100 ton ice plant on Second Ave. Estimated cost $225,000.

Ga., Culverton—The Moore Lumber Co., is in the market for a 150 to 200 hp. boiler (new or used.)

Ill., Aledo—Town plans the construction of a pump house including the installation of pumping equipment, etc. Kinsey Engineering Co., Arcade Bldg., is engineer. Contract for drilling of artesian well, total depth about 1,240 ft., has been awarded.

Ill., Chicago—P. M. Gordon, 3167 Pine Grove Ave., is having preliminary plans prepared for the construction of a 16 story apartment at Pearson and DeWitt Sts. Estimated cost $1,500,000. Guske & Foster, 750 North Michigan Ave., are architects.

Ill., Chicago—M. A. Howell 4911 Winthrop Ave., and S. Smith, plans the construction of a 29 story hotel at Chestnut and Seneca Sts. Estimated cost $2,000,000. Roy F. France & Co., 155 North Clark St., are architects.

Ill., Chicago—Plotke & Grosby, 111 West Washington St., plans the construction of a 24 story hotel at 210-218 Pearson St. Estimated cost $2,000,000. Huszagh & Hill, 6 North Michigan Ave., are architects.

Ill., Chicago — Syndicate, c/o A. A. Schwartz, 720 North Michigan Ave., Archt., is having plans prepared for the construction of a 14 story hotel at Hyde Park Blvd. and Cornell Ave. Estimated cost $1,500,000.

Ill., Springfield—City will receive bids until Dec. 7 for equipment for light and power plant as follows: Sect. 1, surface type with auxiliaries of sufficient capacity to condense steam for a 7,500 kw. General Electric turbine. Sect. 2, air conditioning equipment including air filters or coolers to provide for electric turbines, 7,500 kw., 4,000 kw., 3,000 kw. and 1,500 kw. generators. Sect. 3, two water tube boilers with chain grate stokers, forced draft apparatus, etc. Estimated cost $85,000. Burns & McDonnell, Interstate Bldg., Kansas City, Mo., are engineers.

La., White Castle—City plans an election Dec. 12 to vote $35,000 bonds for the construction of an electric power plant.

Mich., Detroit—Michigan Bell Telephone Co., Cass Ave., plans the construction of a 12 story office building including steam heating system on Cass Ave. Smith, Hinchman & Grylls, 800 Marquette Bldg., are architects.

Mich., Detroit — Public Lighting Comn., 174 East Atwater St., awarded contract for the construction of 4 electric substations in connection with new municipal power plant to W. H. Mueller, 2210 Park Ave. $503,990.

Mich., Pontiac—E. X. Miller, plans the construction of an 8 story hotel including steam heating boilers and equipment on North Saginaw St. Estimated cost $700,000. Pollmar & Ropes, 2539 Woodward Ave., Detroit, are architects.

Minn., Bemidji—State Dept. of Administration & Finance, Capitol, St. Paul, will receive bids until Nov. 30 for the construction of a heating and power plant and addition to college building. Estimated cost $120,000. C. H. Johnston, 715 Capitol Bank Bldg., St. Paul, is architect.

Minn., Minneapolis — A. P. Erickson, Auditor Hennepin County, will receive bids until Dec. 9 for the construction of a pump house including two 1,000 g.p.m. vertical centrifugal pumps with motors, one 8,000 g.p.m. horizontal pump with engine, alternate 15,000 g.p.m. pump with engine, drain tile, etc. Estimated cost $15,000. G. R. B. Elliott Construction Co., 706 1st Ave., is engineer.

Mo., Houston — City plans an election soon to vote $45,000 bonds for improvements to waterworks including deep well and motor driven pumping equipment, 75,000 gal. tank on tower, distribution system, etc. Russell & Axon, McDaniel Bldg., Springfield, are engineers.

Mo., Poplar Bluff—Black River Power & Development Co., c/o W. H. Meredith, has been granted a permit to construct a hydro electric power plant including dam near here. Estimated cost $3,500,000. R. I. Randolph, 38 South Dearborn St., Chicago, Ill., is engineer.

Mo., St. Louis—Polar Wave Ice & Fuel Co., 3638 Olive St., awarded contract for the construction of an ice station at 4622 South Kingshighway, to Woerman Construction Co., Syndicate Trust Bldg. Estimated cost $100,000.

Neb., Spencer — Northern Nebraska Power Co., C. J. Hubbell, Pres., Dewese, has made application to the State Railway Comm., Lincoln, to sell $700,000 preferred stock and $200,000 common stock to finance the development of an electric power plant including a 3,000 ft. dam, dyke, power house, etc. on the Niobrara river near here. Estimated cost $1,000,000.

N. Y., New York—Five Hundred Fifty Three Eighth Avenue Corp., c/o Shampan & Shampan, 188 Montague St., Brooklyn, Archts., is having plans prepared for the construction of a 25 story loft building on 8th Ave. here.

N. Y., New York—H. Lanzner & I. Baer, 152 West 42nd St., plans the construction of a 25 story hotel at Park Ave. and 88th St. Estimated cost $8,500,000. Work will be done by separate contracts under the supervision of owner.

N. Y., New York—Seaman's Bank for Savings, Wall St., awarded contract for the construction of a bank and office building at Wall and Pearl Sts. to William L. Crow Construction Co., 103 Park Ave. Estimated cost $2,000,000.

N. Y., White Plains—H. & S. Sonn, Inc., plans the construction of a theatre and office building on Main St. Estimated cost $2,000,000. Architect and engineer not selected. B. F. Keith-Albee Circuit, Palace Theatre Bldg., New York, is lessee.

O., Cleveland—City is receiving bids until Nov. 27 for substructure for pump house, concrete suction tunnel, 125 ft. long, 10 ft. diameter, screen well, etc. A. Levy, c/o L. A. Quayle, City Hall, is engineer.

O., Wadsworth — Wadsworth Salt Co., plans the construction of a factory including boiler house and engine room. Estimated cost $150,000. W. D. Spengler, 1053 Union Trust Bldg., is architect.

O., Youngstown—Youngstown Ice & Fuel Co., P. B. Hunt, Pres., 1421 West Federal St., awarded contract for the construction of an ice storage building to National Concrete Fireproofing Co., Union Mortgage Bldg. Estimated cost $100,000.

Okla., Bethany—City voted $45,000 bonds for improvements to waterworks system including pumping equipment, mains, etc.

Okla., Frederick — City voted $52,000 bonds for waterworks including the construction of a pump house, pumps, reservoir, mains, etc. Benham Engineering Co., 512 Gumbel Bldg., Kansas City, Mo., is engineer.

Okla., Tishomingo — Oklahoma Gas & Electric Co., has acquired plants from private owners and plans the construction of a 20 ton ice plant, also a new electric system. Estimated cost $100,000.

Pa., McKeesport — National Tube Co., Frick Bldg., Pittsburgh, is having plans prepared for the construction of a 2 story office building on Jerome Ave. Estimated cost $500,000. E. Stotz, Monongahela Bank Bldg., Pittsburgh, is engineer.

Pa., Petrolia—W. H. Daugherty & Sons, plans the construction of an absorption refrigeration plant including brine cooler, ammonia pumps, generator analyzer, D. P. charger, water, brine and charging pumps, two 20 ft. in diameter x 20 ft. deep settling tanks, 5 x 9 x 6 ft. brine tank, etc. Estimated cost $40,000. Carbondale Machine Co., Carbondale, is engineer.

Tenn., Nashville — City council has authorized the expenditure of $1,000,000 and will soon receive bids for the construction of a new boiler plant, auxiliary reservoir, etc. for waterworks at Love's Circle. J. N. Chester, Engrs., Union Bank Bldg., are engineers.

Tex., Corpus Christi — Texas Central Power Co., S. M. Udden, Frost Bank Bldg., San Antonio, is receiving bids for the construction of a 50 ton ice plant. Estimated cost $110,000. Company engineers in charge.

Tex., La Porte—La Porte Ice Co., c/o C. O. Crenshaw, Mgr., is having preliminary plans prepared for remodeling of plant including the installation of compressors, blowers, pumps, filters, etc., 12 ton daily capacity. Estimated cost $40,000. Company engineers in charge.

Tex., Sinton—Sinton Electric & Ice Co., O. McCall, Mgr., is having plans prepared for the construction of a 30 ton ice plant. Estimated cost $100,000. Company engineers in charge.

Tex., Wichita Falls—Witherspoon Co., 104 Barwise St., plans the construction of a cold storage produce house. Estimated cost $60,000. Company engineers in charge.

W. Va., Parkersburg—Ballinger Co., 12th and Chestnut Sts., Philadelphia, Pa., Archt., will receive bids until Nov. 29 for the construction of a group of buildings including boiler house, pump house, etc., here for Viscose Co., Marcus Hook, Pa. Estimated cost $2,000,000.

Wis., Milwaukee—Armour & Co., 131 Muskego Ave., L. A. Evars, Supt. of Construction, will build a 3 story packing plant including refrigeration system by day labor. Estimated cost $65,000. Owner will purchase refrigeration equipment.

Wis., Milwaukee — E. R. Liebert, 49 Oneida St., Archt., is preparing plans for the construction of a 3 story factory including an engine house, etc., on 27th St. Estimated cost $100,000. Owner's name withheld.

Ont., Kirkland Lake—Lake Shore Mine, plans increasing capacity of mine. Additional crushers, compressors, pumps, conveying equipment, electric motors, etc. will be installed.